PROCESS FOR THE UPGRADATION OF ETROLEUM RESIDUE: REVIEW

Rajesh K Gupta[1], Poonam Gera[2]

[1]*Chemical Engineering, Dr. B.R Ambedkar National Institute of Technology, Jalandhar (India)*

[2] *Associate Professor, Chemical Engineering, Dr. B.R Ambedkar National Institute of Technology, Jalandhar (India)*

ABSTRACT

Rising demand of transportation fuels, petrochemicals and the ever-rising heavy residue of crude oil have resulted in a renewed interest in the processing of this heavy residue to generate useful lighter fuels and chemicals. Non-conventional feeds such as VR and heavy oils have shown an alternate source for the production of high value transportation fuels, as it is abundantly available. These feeds are of low quality due to presence of impurities like CCR, Asphaltenes, sulfur, nitrogen and heavy metals. Several process technologies have been developed to upgrade these feeds through fixed-bed, moving-bed, ebullated-bed,

This paper highlights the up gradation of residue or heavy oil by visbreaking, steam cracking, fluid catalytic cracking, and coking; solvent deasphalting; hydrocracking; fixed bed catalytic ;hydroconversion;ebullated catalytic bed hydroconversion,;Nanoparticles;Biological processing of heavy fractions

Keywords: Hydrocracking, Residue, Deasphalting, Nanoparticles, Fixed Bed Catalytic

I. INTRODUCTION

World-wide fuels and petrochemicals are synthesized from coal, petroleum oil and natural gases. According to the United StatesEnergy Information Administration (EIA), total oil demand in the world is expected to growup to 123 mmbpd (million barrels per day) by 2025. In addition, the organization of petroleum exporting countries (OPEC) has estimated that production will be approximately 61 mmbpd by 2025, which is less than half of the demand.

At the same time, non-OPEC countriesare also expecting a steady increase in petroleum oil production (62 mmbpd) by 2025 [1].

As a result of this, refiners are getting burdened with heavy residues that are subsequently obtained by processing heavy crudes. Heavy crudes (≤20 ºAPI) yield large amount of residual fractions such as atmospheric residue (AR, initial boiling point, IBP > 343ºC) and vacuum residue (VR, IBP > 500ºC) as shown in Fig 1.

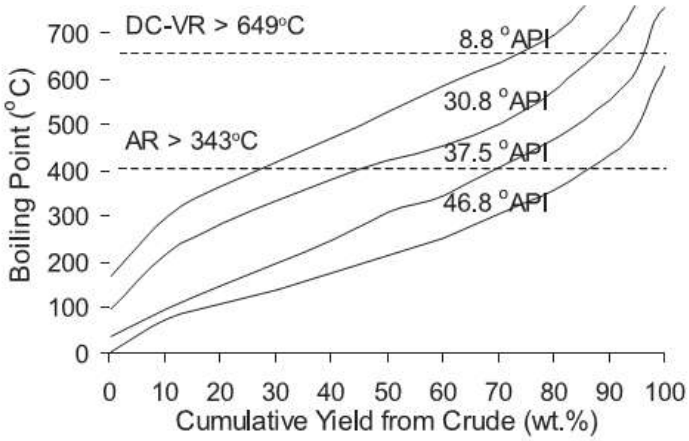

Figure 1. TBP curves for feeds with different API gravity (Boduszynski, 2002)

II. NECESSITY OF RESIDUE UPGRADING

Due to rapid population growth, the consumption of fuels, energy and petrochemical products has increased tremendously and due to this the reserves of conventional (light) crude oil are depleting and there is a gradual but sure decline in crude oil quality. Therefore, there is a dire need to fully utilize the ever-rising heavy residue of crude oil and the limited petroleum resources (Schulman et al., 1993; Bansal et al., 1994; Shen et al., 1998) .Consequently, interest is focused on diverting the crude's residual fraction from its traditional use as a heavy fuel component to processes that either convert the residue into high-value products.

Indian refiners are equally concerned about upgrading the available crude oil for refining, along with other international refiners in the area of residue upgrading, to get more light distillates required for transport fuels and also to provide the needs for the other concerned industries using petroleum products such as fertilizer and petrochemicals. The basic reason for giving extra attention to residue upgrading is that India has less options than to import crude oil with maximum percentage of residues (Sarkar, 1998).

The goals for upgradation of heavy oils and VR are to decrease viscosity and boiling point, demetallation, desulfurization, level of other impurities and increase H/C ratio with high commercial values. A number of catalysts synthesis process and technologies have been developed to upgrade heavy oils, waste materials and VR. Among all technologies for the conversion of heavy oils and VR, slurry-phase hydrocracking is the most considerable as it is applicable to upgrade high impurities feeds.

III. SOURCES OF PETROLEUM VACUUM RESIDUE AND HEAVY OIL

Heavy oils, extra-heavy oils and bitumens are found all over the world. The International Energy Agency (IEA) estimated that approximately 6 trillion ($6x10^{12}$) barrels (bbl) of heavy oils are available worldwide: $2.5x10^{12}$bbl are in Western Canada, $1.5x10^{12}$bbl are in Venezuela, $1x10^{12}$bbl are in Russia, $0.1\text{-}0.18x10^{12}$bbl are in the United States (USA) and rest of the mass is located in other countries. The largest heavy oil reservoirs in the world are located at the north of the Orinoco River in Venezuela. Heavy oils are also located in various countries and are being produced in India, Colombia, Indonesia, China, Mexico, Brazil, Trinidad, Argentina,

Eastern Europe, Ecuador, Egypt, Saudi Arabia, Oman, Kuwait, Turkey, Australia, Nigeria, Angola, the North Sea, Rumania, Iran, and Italy [2, 3].

Most of these resources are currently untapped due to high viscosity [3]. The price of heavy oil varies according to API (American petroleum institute) gravity, as shown in Fig. 2. This figure compares values that were reported in 2002 with those from 2006 [4].

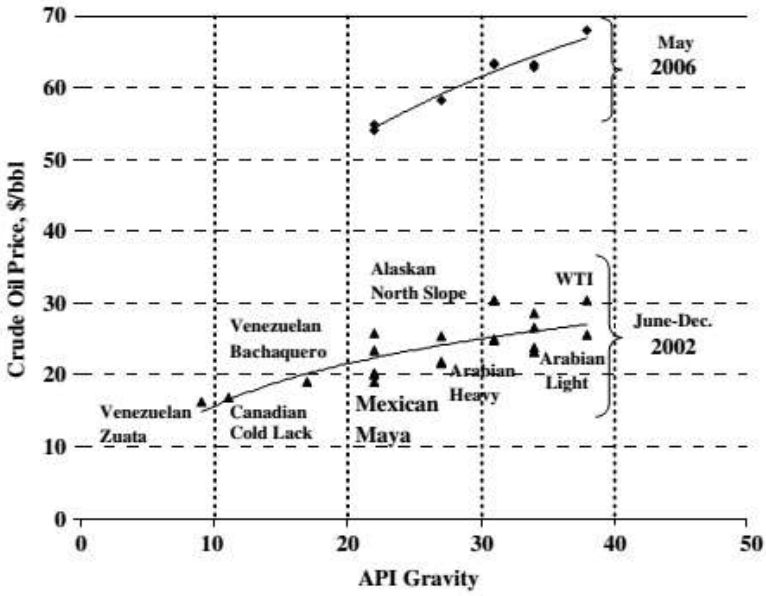

Fig.2 Relationship between Crude Oil Price and API Gravity

About 4100 million metric tons per annum (MMTPA) world-wide petroleum refiningcapacity has reached. In petroleum refining industries, two types of residues are generated. Atmospheric residues (AR,>343°C) are generated atthe bottom of an atmospheric distillation unit. AR is again treated in vacuum distillation tower. Heaviest fractions obtained at the bottom part of the vacuum distillation column tower at 0.003-0.01 MPa are called vacuum residues (VR).

Process	U. S. A.	Japan	Europe	Rest of world	Total
Thermal					
a. Cracking/Visbreaking	6.5	1	108.5	82.5	198.5
b. Coking	93	3	31.5	61	188.5
Deasphalting	13	1	0.5	5	19.5
Hydroprocessing	30.5	30.25	9	49.75	119.5
Resid FCC	31.5	12.5	10.5	37	91.5
Total	**174.5**	**47.75**	**160**	**235.25**	**617.5**

Table 1.World Residue Processing Capacity, MMTPA (Shen Et Al., 1998)

According to the report from 1998, approximately 617.5 million metric tons (MMT) of petroleum residues were upgraded or converted in various processes worldwide, as shown in Table 1. Currently, approximately 725 MMTpetroleum residues are processed through various conversion processes. Conversion of residues or heavy oil has always been aimed to refiners to obtain value-added products [5]

IV. CHARACTERISTICS OF VACUUM RESIDUE AND HEAVY OIL

Heavy oil, or VR, is complex, black in color, highly dense, and extremely viscous in nature with API gravity between 10-20°. It is also high molecular weight, low hydrogen to carbon (H/C) ratio, highly viscous (at room temperature) materials. These materials contain impurities such as nickel, vanadium, iron, calcium, and silica, compounds of nitrogen, oxygen, and sulfur. Based on polarity difference, these materials can be classified into4 organic fractions likesaturates, aromatics, resins, and asphaltenes [6-11] are shown in Table 2.

Percentages of impurities (heavy metals, nitrogen, sulfur, etc.). The properties of VR are varied according to origin (place) and synthetic route. VR can be converted into lighter oil or more value-added products using bottom of the barrel conversion processes or residue upgrading processes elemental analysis, feed compositions of various fractions and ICP analysis are provided in Table 3.

SARA compositions of deasphalted oil and vacuum residue.

Composition (wt%)	DAO	VR
Saturates	27.8	3.7
Aromatics	57.1	68.7
Resins	13.9	14.4
Asphaltenes	1.2	13.2

Table.2

Elemental analysis of deasphalted oil and vacuum residue.

Elemental composition (%)	DAO	VR
C	81.45	79.75
H	10.30	9.37
O	1.20	1.48
N	0.13	0.47
S	1.63	4.20

Table.3

Asphaltene fractions are in various color (from brown to black), non-volatile, amorphous substances which exist as colloids inthe VR or heavy oils. The asphaltenes are composed of nitrogen, oxygen, sulfur, vanadium and nickel compounds. These compounds contain a stack or cluster of naphthenic and aromatic molecules, fused ring aromatic molecules, small aliphatic side chains and polar functional groups (Fig. 3) Asphaltenes are insoluble in n-alkanes such as n-pentane and n-heptane, but soluble in benzene or toluene [12].

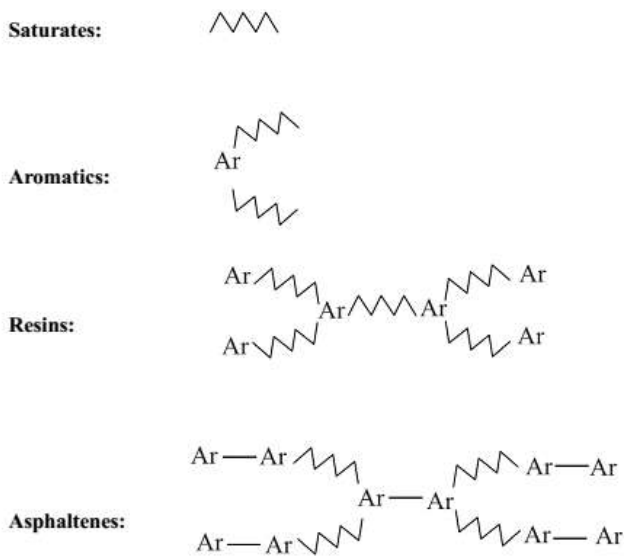

Fig. 3 Major Structural Components of the Vacuum Residue [12]

VR and heavy oils are poor in quality due to presence of asphaltenes, heavy metals and hydrocarbon, and heteroatoms [13]. Asphaltenes and resins are significant fractions in above feeds. Therefore, these feeds must be upgraded before used as fuels or chemicals.

V. DIFFERENT RESIDUE UPGRADING PROCESSES

Technologies for upgrading heavy feedstocks such as heavy oil, bitumen and residua can be broadly divided into carbon rejection and hydrogen addition processes. Carbon rejection redistributes hydrogen among the various components, resulting in fractions with increased H/C atomic ratios and fractions with lower H/C atomic ratios. On the other hand, hydrogen addition processes involve the reaction of heavy feedstock with an external source of hydrogen, which results in an overall increase in H/C ratio. Within these broad ranges, all upgrading technologies can be subdivided as follows:

1. Carbon rejection processes: visbreaking, steam cracking, fluid catalytic cracking, and coking;
2. Separation processes: solvent deasphalting;
3. Hydrogen addition processes: hydrocracking, fixed bed catalytic hydroconversion, ebullated catalytic bed hydroconversion, hydrovisbreaking, hydropyrolysis,
4. Nanoparticles
5. Biological processing of heavy fractions.

Since 1913 carbon rejection process is used in the petroleum refining industries. In this process, the feeds (larger molecule) are heated under inert atmospheric pressure to fracture them into smaller molecules. Internal hydrogen attached to carbon molecule is redistributed among the various components such that some fractions increase their H/C atomic ratios while others decreased their H/C atomic ratios. In this processes induced carbon coke is formed. Conversely, during hydrogen addition processes, the H/C ratio of the feedstock is increased using an external hydrogen source in presence of suitable catalysts.

5.1 Carbon Rejection Processes

Thermal processes (carbon rejection) are animportant for the conversion of VR or heavy oils [14]. Generally, thermal cracking is carried out at moderatepressure; the hydrogen is transferred from larger to lighter molecules, resulting carbon orcoke. In this processes, the C/H ratio is decreased.

In gasification, feeds are heated at high temperatures (>1000ºC) in absence of air. Therefore, heated feeds are converted into major products such as gas, carbon black and ash [15, 16]. Gasification and its combination technologies are alternative efficient processes for power generation and other sectors [17, 18]. Poor selectivity and difficulty in product separation make the gasification processes is less popular than other processes.

Delayed coking has been chosen by many refiners for VR up gradation because the chemical composition of feeds can be varied. During this process, the partial conversion of a liquid product results in completely metal and carbon free products[19-21]. The product selectivity depends on the experimental conditions (temperature, pressure and reaction time). Large amounts of coke formation and low yields of liquid product make this process more expensive. Even considering these disadvantages, delayed coking is still frequently used for refiners.

Fluid coking and flexicoking are other thermal processes. In these processes coke carries heat from the burner to the reactor while serving as a reaction site for the conversion of VR into various products. The residence time of the liquid reactant in the reactor determines the coke and product formation [22]. The operating conditions and costs of thermal processes are shown in Table 4 and in Fig. 5, respectively.

Visbreaking is the oldest, cost effective option for residual up gradation. Generally, 7 wt% gas and gasoline like product is observed [23]. However, during this process, asphaltene content does not vary in the product. Therefore, stable fuel oil is obtained. This process is suitable in those areas which demanded relativelylow motor fuel. If the motor fuel demand increases in these areas and there are no other refiners, delayed coking is used [24]

A major portion (approximately 63 wt. %) of petroleum residues are up graded by thermal processes such as visbreaking and delayed coking. Depending on up grading condition and feedstock composition, various products like naphthas, middle distillates, vacuum gas oils and coke are formed. Recently, significant number of thermal cracking projects is involved to convert VR.

Thermal processing technologies[a]

Residue technology	Licenser	Operating conditions	
		Temperature (°C)	Pressure (MPa)
Delayed coking	ABB LUMMUS FOSTER Wheeler/ UOP ConocoPhillips	480–515	0.61
Visbreaking	ABB Lummus Global	450–510	0.34–2.0
Fluid coking	ExxonMobil	480–565	0.07
Flexicoking	Conoco-phillips Halliburton KBR	830–1000	
Gasification	Chevron Texaco	>1000	–

[a] Several literature based data.

Table 4 Thermal Processing Technologies and Reaction Conditions

Thermal processes and technologies based on coking have disadvantages of producing a large amount of low value by-products that required further processing. The integrated processes are expensive and time consuming. Therefore, the thermal processes are less important than catalytic upgrading processes of VR.

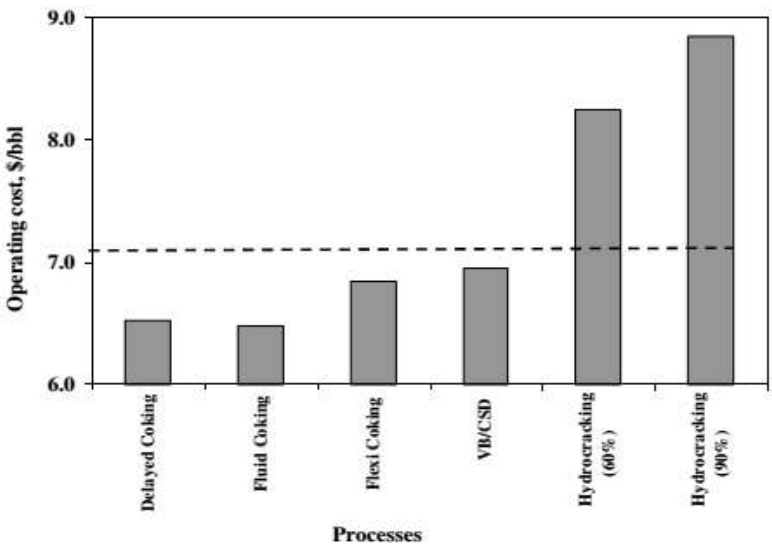

Fig. 5 Operating Costs for Various Processes

Residue fluidized catalytic cracking (RFCC) is an extension of fluidized catalytic cracking (FCC) which was developed in early1980. This method requires a vapor phase for the catalytic cracking reaction that exhibits better selectivity for gasoline and low gas yields than thermal processes. Residues (VR & AR) have high boiling point as well as high content of impurities (metals and heteroatom) which makes the feeds difficult to vaporize. At the end of the reaction, metal and coke deposits on the catalyst surface, as a result catalyst gets deactivate. To process these feedstock's, it must contain relatively low amounts of metal, sulfur, and asphaltenes, or required good quality feedstocks. Therefore, the usefulness of RFCC is limited in industrial applications [25].

5.2 Separation Processes: Solvent Deasphalting

Solvent de-asphalting and thermal (gasification, delayed coking, fluid coking, flexi coking and visbreaking) processes are non-catalytic while residue fluid catalytic cracking (RFCC) and hydro processing (fixed-bed hydro treating and hydrocracking, slurry-phase hydrocracking, ebullated-bed hydro treating and hydrocracking) are catalytic. Fig.4 illustrates the worldwide distribution of residue conversion technologies.

Solvent de-asphalting involves physical separation (metals and asphaltenes) of constituents in the feed according to their molecular weight instead of their boiling point [26-28]. The feeds are mixed with light paraffinic solvents such as propane, butane, n-pentane and n-heptane. Asphalting and other impurities are insoluble in the paraffinic oil. The insoluble portion is separated from the mixture. High energy costs, low demand for motor fuel and the limited uses of de-asphalted products are the limitations of this process. However, interest in de-asphalting is increasing. Solvent de-asphalting processes may be sufficient for residue upgrading [24]

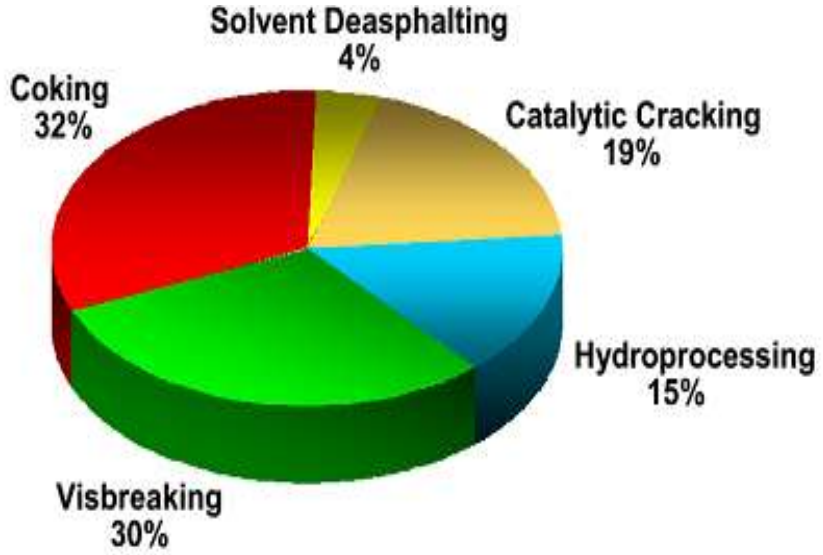

Fig. 4 Historical Worldwide Residue Conversion Selection [24]

5.3 Hydrocracking Technology

During the past three decades, hydrocracking has gained prominence in light petroleum refinery processes [29, 30]. After full industrialization of light petroleum oil hydrocracking processes are gradually applied for heavy oil and VR up gradation [31, 32]. Various hydrocracking reactor technologies suchas fixed-bed, ebullated-bed, moving-bed or slurry-phase reactors are used to upgrade heavy residues [33].

The principles of these reactor operations are almost same butdiffering with respect to some technical minutiae and tolerance of impurities [34]. InTable 5 outlines the comparison of different processes. As can be seen from

Table 5, the non-catalytic carbon rejection processes score higher than other processes in simplicity and operating costs and hence have large numbers of units in the world.']'' In table 6 processes and their licensers are offered.

	Non-catalytic	Catalytic	Extraction	Hydrogen addition
Simplicity	High	Medium	Medium	Low
Flexibility	Low	High	Low	High
Cost	Low	Medium	Medium	High
Quality of products	Low	Medium	Medium	High
Resid conversion level	Medium	Medium	Medium	High
Rejection as fuel oil	Medium	Medium	Medium	Medium
Rejection as coke	High	Medium	Medium	Medium
No. of units in world	Large	Large	Average	Average
Recent trends	High	Medium	Medium	Medium
Environmental pollution	High	Medium	Nil	Low
On stream factor	Poor	Medium	Medium	High
Problems	Coke disposal	Heavy residue	High energy	Hydrogen requirement

Table 5.Comparison of Different Processes (Sarkar, 1998)

Product selectivity depends on catalyst properties (shape, size, active sites, chemical composition etc.) and experimental conditions. The reaction conditionsfor each technology are entirely different. Therefore,nature of the feed, use of proper reactor system and catalysts are very much important for the hydrocracking of VR. Generally, hydrotreatment of the middle distillates or a high API gravity feeds are conducted in fixed-bed reactors, while more complex feeds are used in moving-bed or ebullated-bed reactors.

A fixed-bed reactor requires continuous withdrawal of deactivated catalysts and immediate addition of fresh catalysts. In moving-bed reactors, the fresh catalyst enters at the top of the reactor, and the deactivated catalyst leaves the bottom of the reactor [35-38].

In a moving-bed reactor, the catalyst expands, and thus, the pressure drop can be reduced in some extent [39]. Generally, the hydrocracking of heavy feeds in fixed-bed reactor requires mixed or multiple beds of catalysts. Detailed catalysts syntheses and their applications in fixed-bed reactor systems have previously been reviewed [40, 41]. If the feed quality is too low for a fixed-bed reactor, moving-bed reactors in series orcombinations of ebullated-bed with fixed-bed reactors can be effective [42].

Residue hydroconversion processes[a]

Reactor type	Process	Licenser
Fixed bed	Continuous catalyst replacement (OCR)	Chevron Lumus Global (CLG)
	UFR, Up-flow reactor	Shell (Bunker flow)
		Axen (Swing reactor)
	Hycon, Bunker type reactor	Shell
	Hyvahl, swing reactor concept	IFP (Axen)
Ebullated bed	H-Oil	Axen (HRI/IFP)
	T-Star	Chevron
	LC-Fining	ABB Lummus
		Amoco oil (BP)
Slurry system	Microcat – RC	ExxonMobil
	Veba combi-cracking	Veba Oel
	Hydrocracking distillation hydrotreating (HDH)	Intevep
	Cash, Chevron activated slurry hydroprocessing	Chevron
	EST, Eni slurry technology	Eni Technologies
		Snamprogetti
	CanMet	Energy Research Laboratories, Canada

HRI (Hydrocarbon Research Institute).
[a] Several literature based data.

Table 6

5.4 Residue up Gradation by Nanoparticle

Nanotechnology has emerged as an alternative technology for in-situ heavy oil upgrading and recovery enhancement. Nanoparticle catalysts (Nano catalysts) are one of the important examples on nanotechnology applications. Nan catalysts portray unique catalytic and sorption properties due to their exceptionally high surface area-to-volume ratio and active surface sites. In-situ catalytic conversion or upgrading of heavy oil with the aid of multi-metallic nan catalysts is a promising cost effective and environmentally friendly technology for production of high quality oils that meet pipeline and refinery specifications. Further, nanoparticles could be employed as inhibitors for preventing or delaying asphalting precipitation and subsequently enhance oil recovery.

5.4.1Hydrocracking of Vacuum Residue into Lighter Fuel Oils Using Nanosheet-Structured S_2 Catalyst

In this study, the hydrocracking of vacuum residue into lighter liquid oils using dispersed colloidal catalysts composed of nanosheet-structured WS_2materials. The vacuum residue of API gravity = 2.3was used as a reactant and hydrocracking reactions were performed in an autoclave batch reactor under 400C and the initial H_2pressure of 70 bar. Both single and multi-layer WS_2nanosheet catalysts were tested and their activities were compared with those of bulk WS_2 and MoS_2catalysts. [43]

The single-layer WS_2, which was the highest in specific surface area (97.6 m^2/g) due to its smallest particle size, showed the best performances in commercial fuel fraction yield (45.4 wt.%), C5-asphaltene conversion (75.3%),API gravity of liquid product (13.8), and metal removal activity. The fig 5 shows the graphical process description.

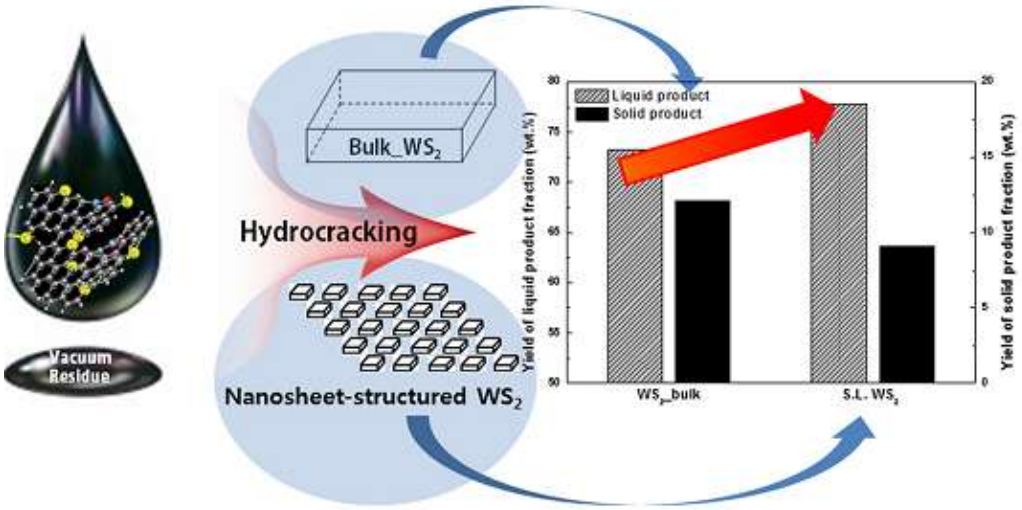

Fig.5 Graphical Process Description [43]

To characterize the physicochemical properties of catalyst, various characterization techniques were applied, including transmission electron microscope (TEM), X-ray diffraction (XRD) and Brunauer–Emmett–Teller (BET) analysis. In addition, to assess the qualities of hydrocracking products, they carried out API gravity measurement, inductively coupled plasma-mass spectrometry (ICP-MS), and simulated distillation (SIMDIS) analysis

5.5 Biological Processing Of Heavy Fractions

Biological processing of heavy fractions of crude oils offers less severe process conditions and higher selectivity for refining. Biochemical Processes are expected to be low demand energy processes and certainly ecofriendly. Since biological processing of heavy crude oil may offer less severe processing conditions in refineries and higher selectivity to specific reactions to increase net distillates, it is proposed that the microorganisms capable to biodegrade heavy fractions of VR, could present an applicable opportunity for upgrading heavy crude oils [44-46].Bactria able to biodegrade various components of petroleum hydrocarbons such as poly-nuclear aromatic hydrocarbons (PAHs), like anthracite, monoaromatichydrocarbons such as toluene, or aliphatic hydrocarbons such asn-alkanes, are widely reported, particularly frompetroleum-contaminated sites [47,48-51]. But there are few reports on isolates that can alter several problematic petroleum components simultaneously, which are all find in VR.

The microbial decontamination of petroleum-polluted soils seems to be an efficient, economic, and versatile alternative to physicochemical treatments. Several abiotic and biotic parameters including the conditions for microbial degradation activity (e.g., presence of nutrients,oxygen, pH, and temperature), the quality, quantity, and bioavailability of the contaminants (e.g., particle size distribution), and the soil characteristics, which are hardly to be controlled in the in situ condition, affect the rate of microbial degradation of hydrocarbons in soils.

Therefore the bacteria with high physicochemical endurance and degradation ability could be a proper choice not only in bioremediation but also in other aspects of oil industry, like heavy oil bio-upgrading or microbial enhanced oil recovery.

The result of VR chemical analysis for the percentage of alkanes, aromatics, asphaltenes and resins, usingSARA test after 20 days treatment with the bacterium in different media, is illustrated in Figure 6.The selected bacterium was able to grow in a wide rangeof pH from 5.5 to 8, salinity up to 3% and temperature from 20°C to 55°C.

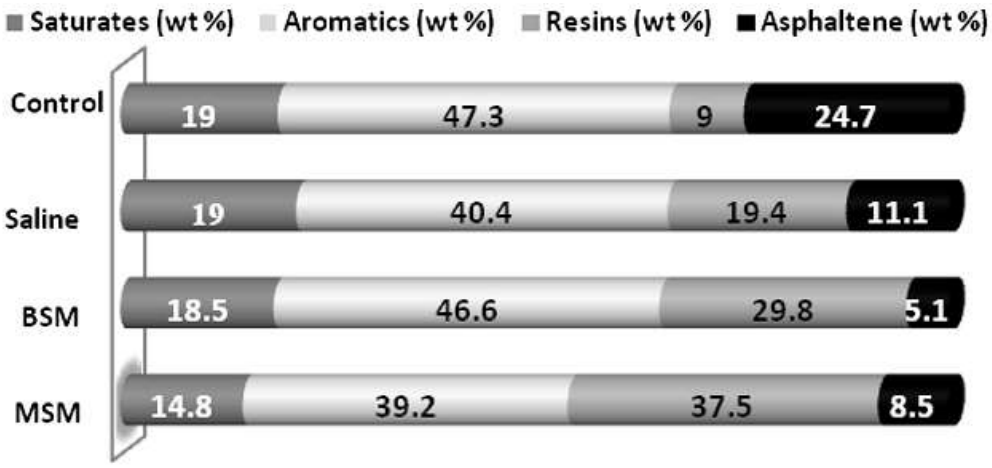

Figure 6 SARA Content Weight Percent [52]

In this process they find that Astrain of biosurfactant producing bacterium was isolated from an oil contaminated soil at Tehran refinery distillation unit. Based on selected phenotypic and genotypic characteristic including morphology, biochemical proprety, and 16 SrRNA sequencing identified as a novel strain ofBacillus cereus (JQ178332). This bacterium endures a wide range of pH, salinity and temperature. This specific strain utilizes both paraffin and anthracene as samples of aliphatic and polycyclic aromatic hydrocarbons. The ability of this bacterium to acquire all its energy and chemical requirements from Vacuum Distillation Residue (VR), as

a net sample of problematic hydrocarbons in refineries, was studied. SARA test ASTM D4124-01 revealed 65.5% decrease in asphaltenic, 22.1% in aliphatics and 30.3% in Aromatics content of the VR in MSM medium. Further results with 0.9% saline showed 55% decrease in asphaltene content and 2.1% Aromatics respectively

VI. CURRENT & FUTURE DEVELOPMENTS

In next few years, crude oil will be heavier due to high contents of impurities, like nitrogen, sulfur and metal. Refineries must improve the process technology used for hydrocracking of heavy feeds into valuable environmentally friendly products. Currently, fixed-bed, moving-bed, expanded-bed or ebullated-bed reactors are available for upgrading the heavy oils and VR. Moreover, the slurry-phase hydrocracking process is attractive when combined with the existing technology and product price structure.

Heavy oil and VR contain complex molecules that pose numerousproblems during up gradation. To upgrade these feeds, the process technology, various related factors such as properties of the feeds, catalyst activity and selectivity, chemical kinetic parameters, operating conditions, and contact time are important factors for achieving a high yield of the selected product. The main challenge involves combining these aspects at reasonable capital costs. During the hydrocracking process, the catalyst should tolerate metal and other impurities possesses in feeds as well as exhibiting high performance (activity, selectivity, stability and regenerability) and being cost effective. These are the main challenges for refineries. Some integrated processes (Shell's Hycon System, Chevron's OCR System, and Axens/IFP's Hyvahl System) have been developed and commercialized. However, in fixedbed processes, online catalyst replacement is preferable to a batch mode reactor, but this process cannot handle heavier oils and higher metal impurities; much improvement is needed in reactor design and operation conditions. An ebullated-bed process shows more selectivity, high conversion of feeds, high liquid yield and relatively low hydrogen consumption.

However, the back mixing of the reactants, high operating costs, high investment and low reactor efficiency are the main hurdles for hydrocracking of VR. Before slurry-phase processes commercialized, some impediments must be overcome. The main steps include optimizing the reaction conditions, lowering the reactor design cost, and using highly active and selective catalysts. The surface area, pore diameter, particle size, metal compositions and components, and metal particle distribution determine the activity and selectivity of the catalyst. The catalysts are also reasonably price having high mechanical strength and are recyclable. Hence, some attention must be paid to catalyst design. In industry, catalysts based on alumina or silica alumina must be exploited. In the near future, the VR upgrading technologies are likely to combine various hydroprocessing technologies with other processes, such as the thermal processes and solvent de-asphalting processes.

And in the field of Nanoparticle to find a proper method for catalyst recovery (or reuse) is another important subject to be dealt in the future studies. [43]

VII. CONCLUSIONS

The demand of transportation fuels and petrochemical applications are rapidly increasing. Unlike limited amount of traditional light petroleum resources, low quality heavy oils and VR are abundant. Therefore, techniques, which can upgrade heavier petroleum resources, need to be developed. One of the most efficient methods for such purpose is catalytic hydrocracking. The slurry-phase hydrocracking process is effective and is

an attractive option for overcoming the limitations associated with other technologies. The main objective is to treat the heavier residue toobtain high quality products, low boiling point liquid with low viscosity.

For hydrocracking processes, coke formation can be suppressed in hydrogen rich atmosphere, and therefore, catalytic life time can be prolonged with high catalytic activity. Hydrocracking catalyst performance can be controlled by types of supports, composition, preparation procedure, and process conditions. Therefore, a strategic catalyst development is essential to obtain high activity and selectivity for hydrocracking of VR and other heavy oils. Simultaneously, deactivation caused by metal impurities and physical damages should also be considered. In addition, life span of the catalyst may be extended by changing its textural properties.

The activity of nanosheet-structured WS_2catalyst was examined for hydrocracking of extra-heavy oil (vacuum residue). A key factor in hydrocracking reaction using dispersed WS_2catalystwas the particle size of catalyst, which determines the concentration of catalyst particles per unit volume of reactant oil phase. The single-layer(S.L) WS_2catalyst, which was the smallest in size among the tested WS_2 catalysts, showed the best hydrocracking activity for vacuumresidue: It was the highest in production of liquid fuel products,especially the commercial liquid fuel fractions such as naphtha,middle distillate, and gas oil. The single-layer(S.L). WS_2catalyst was the most active in hydrocracking of the heavy fractions in vacuum residue,which led us to expect its overall good activity in hydrocracking of other kinds of extra-heavy oils. The S.L. WS_2 catalyst was also the most active for removal of metal impurities (nickel and vanadium) entrapped in the vacuum residue. [43]

The high physicochemical endurance of Bacillus cereus isolated from petroleum contaminated soil with the ability to utilize both aliphatic and complex aromatic structures of distillation residual substances as its sole sourceof carbon and energy, and the particular finding of thisresearch that revealed the remarkable ability of the bacterium to use VR as the only source of all required chemicals for growth along with surfactant production, make this bacterium a unique option for industrial use, particularly in bioremediation, bio-upgrading and bio refining processes. This bacterium with ability to biodegrade and utilize heavy fractions of vacuum distillation residue as its sole source of carbon and energy can be useful in petroleum biological processing with less severe condition to increase net distillates [52]

REFERENCES

[1] M. J. Hutzler, S. Sitzer, P. D. Holtberg, J. Conti, J. M. Kendell,A. S. Kydes, “Annual Energy Outlook 2003 with projection to 2025” The United States Energy Information Administration, US Department of Energy, Washington, DC 205, 85 (2003) 267.

[2] L. Atkins, T 3.Higgins, C .Barnes, “Heavy crude oil global analysis and outlook to 2030” Hart energy consulting report, Houston, Texas, USA, 2010.

[3] D. Vartivarian, H. Andrawis, Oil Gas J 104 (2006) 52.

[4] F. E Biasca, R. L. Dickenson, E. Chang, H. E. Johnson, R. T. Bailey, D. R. Simbeck, In upgrading heavy crude oils and residue to transportation fuel: technology economics and outlook, Phase 7, Garland R. Report Coordinator, SAF Pacific Inc. Eng. & Economic Consultant, 2003.

[5] K. E. Rose, Hydrocarbon Process. 7 (1971) 85.

[6] M. R Gray, “Upgrading petroleum residues and heavy oils” CRC Press, New York, 1994.

[7] J. G. Speight, “The chemistry and technology of petroleum” CRC Press, New York, 2006.

[8] S. Rahmani, W. McCaffrey, M. R. Gray, Energy Fuels 16 (2001)148.

[9] J. Ancheyta, G. Centeno, F. Trejo, G. Marroquín, Energy Fuels 17 (2003)1233.

[10] J. Schmidt, http:// findarticles.com/p/articles /mim3159/is12226/ 15979981, 2010.

[11] W. Kotowski, W. Fechner, B. Lucke, Przem. Chem. 2 (1999) 51.

[12] S. Sugianto, R. M. Butler, J. Can. Petrol. Technol. 29 (1990) 78

[13] R. Quann, R. A. Ware, C. W. Hung, J. Wei, Adv. Chem. Eng. 14 (1988) 95.

[14] R. L. Dickenson, F. E. Biasca, B. L. Schulman, H. E. Johnson, Hydrocarbon

[15] T. Tsujino, Fuel Energy Abstr. 37 (1996)183.

[16] R. V. Pindoria, A. Megaritis, I. N. Chatzakis, L. S. Vasanthakumar, S. F. Zhang, M. J. Lazaro, Fuel 76 (1997)

[17] O. Holopainen ,Bioresour. Technol. 46 (1993) 125.

[18] F. Gulli, Energy Policy 23(1995) 647.

[19] B. G. Houk, Fuel Energy 37 (1996) 176.

[20] A. Tokarska, Fuel 75 (1996)1094.

[21] F. R. Reinoso, P. Santana, E. R.Palazon, M. A. Diez, H. Marsh. Carbon 36 (1998)105.

[22] E. Furimsky, Fuel Process Technol. 67(2000) 205.

[23] B. I. Zuba, Hydrocarbon Process.10 (1998)132.

[24] A. Billon, F. Morel, J. P. Peries, "Use of solvent deasphalting process in Residues Conversion schemes" 15th World Petroleum Congress, Beijing, China, 1997.

[25] H. Shen, Z. Ding, R. Li, "Thermal Conversion-An Efficient Way for Heavy Residue Processing" in Proc. 15th World Petroleum Congress, 2 pp. 907-913, Beijing, China, 1998.

[26] S. L. Chen, S. S. Jia, Y. H. Luo, S. Q. Zhao. Fuel 73 (1994)439

[27] V. A. Adewusi, B. Ademodi, T. Oshinowo. Fuel Process. Technol. 27 (1991) 21.

[28] C. W. Curtis, K. J.Tsai , J. A. Guin. Fuel Process Technol.16 (1987) 71.

[29] J. W. Scott, A. G. Bridge, Advan. Them. Ser. No. 103 (1971)113.

[30] J. W. Scott, N. J. Patterson, Proc. 7th Wld. Petrol. Congr. 4 (1967) 97.

[31] G. L. Farrar, Oil Gas J. 71 (1973) 25.

[32] D. H. Stormont, Oil Gas J. 66 (1968) 104.

[33] J. Cherzer, A. J. Gruia, "Hydrocracking Science and Technology" Marcel Dekker, New York, 1996.

[34] E. Furimsky, Appl. Catal. A 46 (1988) 177. [35] G. N. Sarkar, "Advanced Petroleum Refining" Khanna Publishers, New Delhi, 1st Ed., 1998

[36] J. W. Gosselink, Cattech 2 (1998) 127.

[37] S. Kressmann, F. Morel, V. Harle, S. Kasztelan, Catal. Today 43 (1998) 203.

[38] B. E. Reynolds, R. W. Bachtel, K. Yagi, "Chevron's on stream catalyst replacement (OCRTM) provides enhanced flexibility to residue hydrotreaters" Presented at the 1992 NPRA Annual Meeting, New Orleans, LA, 1992.

[39] J. Ancheyta, J. G. Speight, "Reactors for Hydroprocessing of Heavy Oil and Residua" Chapter 6, Eds., Taylor and Francis, New York, 2007.

[40] E. Furimsky, F. E. Massoth, Catal. Today 52 (1999) 381.

[41] L. E. Gardner, S. G. Kukes, "Hydrofining employing a support material for fixed beds" US 4828683, 1989.

[42] J. Ramirez, M. S. Rana, J. Ancheyta, J. G. Speight, "Characteristics of heavy oil hydroprocessing catalysts" Chapter 6, Eds., Taylor and Francis, New York, 2007.

[43] Y.G. Hur et al. / Fuel 137 (2014) 237–244.

[44]. Sood N, Lal B: Isolation and characterization of a potential paraffin-waxdegradingthermophilic bacterial strainGeobacilluskaustophilusTERINSMfor application in oil wells with paraffin deposition problems.Chemosphere2008, 70:14451451.

[45]. Vazquez-Duhalt R, Quintero-Ramirez R: Prospects for biological upgrading ofheavy oils and asphaltenes, Petroleum Biotechnology: Developments andPerspectives.4th edition. The Netherlands: ELSEVIER B.V; 2004:113143.

[46]. Wang XB, Chi CQ, Nie Y, Tang YQ, Tan Y, Wu G, Wu XL:Degradationofpetroleum hydrocarbons (C6-C40) and crude oil by a novelDietziastrain.Bioresource Technol2011,102(17):7755–61.

[47] Liu W, Luo Y, Teng Y, Li ZQ, Ma L: Bioremediation of oily sludgecontaminated soil by stimulating indigenous microbes.EnvironGeochemHealth2010, 32(1):23–29

[48]. Karimi A, Golbabaei F, Neghab M, Reza PM, Nikpey A, Mohammad K,MehrniaMR:Biodegradation of high concentrations of benzene vaporsin a two phase partition stirred tank bioreactor. Iranian J Environ HealthSci Eng2013, 10:10.

[49]. Kim IS, Park J, Kim KW:Enhanced biodegradation of polycyclic aromatichydrocarbons using nonionic surfactants in soil slurry.Appl Geochem2001,16:1419–1428.

[50]. Östberg TL, Jonsson AP, LundströmUS:Enhanced degradation of n-hexadecanein diesel fuel contaminated soil by the addition of fermented whey.Soil Sediment Contamination2007,16(2):221–232.

[51]. Whyte IG, Bourbonniere I, Greer CW:Biodegradation of petroleumhydrocarbons by psychrotrophicpseudomonasstrains possessing bothalkane (alk) and naphthalene (nah) catabolic pathways.Appl EnvironMicrobiol1997,63(9):3719–3723

[52] Tabatabaee and MazaheriAssadi Journal of Environmental Health Sciences & Engineering2013, 11:18

A SURVEY OF SWARM INTELLIGENCE BASED ANT AD HOC ROUTING PROTOCOLS

Purneshwari Varshney[1], Kapil Dave[2]

[1]*Research Scholar, Department of Electronics & Communication Engineering, MBM Engineering College, JNVU, Jodhpur, (India)*

[2]*Assistant Professor, Department of Electronics & Communication Engineering, JIET Group of Institutions, Jodhpur, (India)*

ABSTRACT

A Mobile Ad-Hoc Network (MANET) is a collection of self-organizing wireless mobile nodes forming a temporary network without using centralized access points. In MANET, each node can act as a node as well as a router. But due to non-availability of centralized administration, there is a problem of routing optimization. There are various protocols like AODV, DSDV, ZRP etc. available for routing in MANET. Swarm Intelligence (SI) is an artificial intelligence technique based around on the study of collective behaviour in decentralized, self-organized systems. Ant Colony Optimization is popular among other Swarm Intelligent Techniques. Ants-based routing algorithms have attracted the attention of researchers because they are more robust and reliable than other conventional routing algorithms. They are suitable for mobile ad-hoc networks where nodes move dynamically and topology changes frequently. In this paper, different ant based routing protocols are studied.

Keywords*: *Ant Based Routing Protocol, MANET, ACO, PERA

I INTRODUCTION

Wireless networks have become increasingly popular in the computing industry. This is particularly true within the past decade, which has seen wireless networks being adapted to enable mobility. There are currently two types of mobile wireless networks. The first is known as the infrastructure network (i.e., a network with fixed and wired gateways). The bridges for infrastructure networks are known as base stations. A mobile unit within these networks connects to, and communicates with nearest base station that is within its communication radius. When the mobile travels out of range of one base station and into the range of another, then a “handoff” occurs from the old base station to the new base station and the mobile is able to continue communication seamlessly throughout the network. Typical applications of this type of network include office wireless local area networks (WLANs). The second type of mobile wireless network is the infrastructure less mobile network, commonly known as an ad hoc network. These networks have no fixed routers; all nodes are capable of movement and can be connected dynamically in an arbitrary manner. Nodes of these networks function as node as well as routers which discover and maintain routes to other nodes in the network. Example applications of ad hoc networks are sensor nodes

send to route events (images) captured to a particular destination (sink) using the most efficient path. The power and bandwidth for transmitting video data from hundreds of cameras to a central location for processing at a high success rate would be enormous. In this, captured packets were routed from different sensors placed at different locations to the sink using the best path. Since the captured images (packets) need to be routed to the destination (sink) at regular interval and within a predefined interval of time, while consuming low energy without performance degradation, Ant based routing which utilizes the behaviour of real ants searching for food through pheromone deposition, while dealing with problems that need to find paths to goals, through the simulating behaviour of ant colony is adopted. Other examples are emergency search-and rescue operations, meetings or conventions in which persons wish to quickly share information, and data acquisition operations in inhospitable terrain. In recent years, several wireless routing protocols are designed to provide communication in wireless environment, such as AODV, DSDV, ZRP, LAR, OLSR and DYMO etc.

II GENERAL FRAMEWORK FOR SWARM INTELLIGENCE BASED ROUTING

The framework consists of five top level modules. The ensemble of these modules and sub modules implements the architecture and the operations at the node router. The top level modules are:

- Mobile agents generation and management
- Routing information database (RID)
- Agent communications
- Packet forwarding.

2.1 Mobile agent generation and management

SI-based routing protocols commonly use two types of agents to collect routing information. ACO-based protocols call them forward and backward ants. Forward ants are launched by source nodes to determine a path to an intended destination – we call them forward agents in framework. Once a forward agent reaches at its destination, it travels back to the source node as a backward agent. Some protocols use other types of agents to participate in routing process.

- Forward agents control

The main duty of a forward agent is to discover a path leading from the source to a given destination node. Also, they collect routing information on their way to the destination (e.g. experienced delay, minimum remaining energy

- Backward agent control

The backward agent control module consists of a generation block, and a forwarding engine. The generation block reactively decides whether to generate or not a backward agent in response to a forward agent received at the destination. Backward agents can be also generated proactively. Backward agent inherits all the information gathered by the forward agent and retraces its path back to the source node. Retracing in ACO-based schemes is executed using a source-routing approach.

2.2 Routing information database (RID)

This is a set of locally maintained data structures that includes the routing tables for agents and data, as well as possible additional data structures holding statistics of interest about node and network status used for path evaluation and for taking decisions. For instance, data concerning the expected queuing time is maintained in the RID. Routing tables, called pheromone tables in ACO. The routing information database can also serve to hold sequence numbers and other information related to passing by agents. This can be used to avoid agents carrying on the complete list of visited nodes (e.g., this is the case of ACO's backward ants), that can result heavily resource-consuming or even infeasible in very large networks. Maintaining sequence numbers at the nodes also serves to avoid the multiple forwarding of an agent originated from a route setup and that has been duplicated through repeated broadcast (this is a typical problem in MANETs protocols based on some form of flooding to find a path).

2.3 Agent communications

The mobile agents share network data as well as sampled and collected paths quality information e.g. using a stigmergic approach, as in ACO-based protocols. The Agent communications module provides the logical and functional interface to mediate agent communications inside the router. It has direct access to the data in the RID and implements the 'formulae' to update routing tables and statistics. So, it is central to control the degree of adaptivity of the system.

2.4 Packet forwarding

This module deals with the local forwarding of data packets. It makes use of the information built by the agents and available in the RID. It consists of a path selection unit and a forwarding unit. Data packets can be routed either through multiple paths or through the best path. In multipath approach, the selection of a path among the set of available next hops is done at the source node (as in case of source routing) or at intermediate nodes (next hop routing) in a stochastic or deterministic fashion.

III ANT BASED ROUTING PROTOCOL

ANT Based Routing Protocol has taken the inspiration from real ants which are wandering around their nests to forage for search of food. Upon finding food they will return back to their nests and simultaneously deposit pheromone trails along the paths. The ant selects its next hop based on the amount of pheromone deposited on the path to the next node. The problem of finding shortest paths maps quite well to the problem of routing in networks. The ants are nothing but small control packets, which have the task to find a path towards their destination and gather information about it. Ant-like mobile software agents, who are analogous to the ones used real ant colony's biological behaviour, are employed for discovering network topologies and thus efficient routing in the networks. Ant-like mobile agents are an effective means to discover the network topology in particular in circumstances such as MANET in which the network topology frequently changes. Routing based on ant-like agents does not require frequent exchanges of update messages for routing tables. As the population of the

network becomes dense, an ant-like agent becomes more effective for load balancing in the network. Ant-like agents are a known means to mitigate congestion.

Table 1: Comparison between Mobile Ad Hoc Networks and Ants

Parameters	MANETs	Ants
Physical structure	Unstructured, dynamic & distributed	Unstructured, dynamic & distributed
Origin of route	Route requests are sent from source to get local information	Pheromones are used to build new routes
Multipath support	Single path, partially multipath	Provide multipath
Basic System	Self-Configuring and self-organizing	Self-Configuring and self-organizing
Goal	To find the shortest path	Guaranteed shortest path

The pheromones may be used as a measure for any metric under consideration such as average delay, bandwidth and jitter. The basic principle of all these algorithms is that current traffic conditions and link costs are measured by transmitting "artificial ants" into the network. These ant packets mark the travelled path with an "artificial pheromone," that is, update the routing table depending on the collected information. Therefore, they increase the probability of choosing a certain link for a given destination. Results from ant based routing applications in fixed and wired network are very promising.

3.1 Ant Net

AntNet is an algorithm conceived for fixed, wired networks, which derives features to use two different network exploration agents, i.e. forward and backward ants (BANTs), which collect information about delay, congestion status and the followed path in the network. Forward ants (FANTs) are emitted at regular time intervals from each node to a randomly selected destination. This transmission occurs asynchronously and concurrently with the data traffic. As soon as a FANT arrives at the destination, a BANT moves back to the source node reverse the path taken by the FANT. The subdivision in forward and BANTs has the following reasons. The FANTs are just employed for data aggregation of trip times and node numbers of the path taken without performing any routing table updates at the nodes. The BANTs get their information from the FANTs and use it to achieve routing updates at the nodes. Each node in the network maintains two structures, which the agents co-operate with and concurrently read and write to routing table.

3.1.1 Ant Based Control

Ant based control (ABC) is another stigmergy based ant algorithm designed for telephone networks. It shares many similarities with AntNet, but also incorporates certain differences. The basic principle relies on mobile routing agents, which randomly explore the network and update the routing tables according to the current

network state. The routing table, storing probabilities instead of pheromone concentrations, is exactly the same as in AntNet. Also, probability balanced randomness of the ants" path selection is employed to favour the detection of new routes. One important difference applies to the use of the routing agents is; ABC only uses a single class of ants (i.e. FANTs), which are initiated at regular time intervals from every source to a randomly chosen destination. After arriving at a node they immediately update the routing table entries for their source node, meaning that the pheromone pointing to the previous node is increased. It is important to see that only the backward path is influenced, and just packets travelling towards the ant's source profit from that route update.

3.1.2 Probabilistic Emergent Routing Algorithm (PERA)

This algorithm works in an on-demand way, with ants being broadcast towards the destination at the start of a data session. Multiple paths are set up, but only the one with the highest pheromone value is used by data and the other paths are available for backup. The route discovery and maintenance is done by flooding the network with ants. Both forward and backward ants are used to fill the routing tables with probabilities. These probabilities reflect the likelihood that a neighbour will forward a packet to the given destination. Multiple paths between source and destination are created. First of all, neighbours are discovered using HELLO messages, but entries are only inserted in the routing table after receiving a backward ant from the destination node. Each neighbour receives an equi- probable value for destination. This value is increased as a backward ant comes from that node, establishing a path towards destination. As ants are flooded, the algorithm uses sequence numbers to avoid duplicate packets. Only the greater sequence number from the same previous hop is taken into account. Forward ants with a lower sequence number are dropped. This approach is similar to AODV Route Request packets, but discovers a set of routes instead of one. Data packets can be routed according to the highest probability in the routing table for the next hop.

3.1.3 Ant Agents for Hybrid Multipath Routing [AntHocNet]

AntHocNet is a multipath routing algorithm for mobile ad-hoc networks that combines both proactive and reactive components. It maintains routes only for the open data sessions. This is done in a Reactive Route Setup phase, where reactive forward ants are sent by the source node to find multiple paths towards the destination node. Backward ants are used to actually setup the route. While the data session is open, paths are monitored, maintained and improved proactively using different agents, called proactive forward ants.

IV CONCLUSION

Ants-based routing algorithms have attracted the attention of researchers because they are more robust, reliable, and scalable than other conventional routing algorithms. Moreover, ant based protocols are biological derived which developed after thousands of years practical experiences. The researches done have shown that ant based routing protocols can remove at least one or several problems in the area such as battery life, scalability, maintainability, survivability, adaptability and so on. As such, ant based approaches are attracted by much researchers than other approaches.

REFERENCES

[1] Sudarshan D Shirkande and Rambabu A Vatti, ACO Based Routing Algorithms for Ad-hoc Network (WSN,MANETs):A Survey, IEEE 2013 International Conference on Communication Systems and Network Technologies.

[2] B.M.G. and P.V.S. Srinivas,SAMR: Swarm Adaptive Multipath Routing Topology for Load balancing and Congestion Endurance in Mobile Ad hoc Networks, 2013 Third International Conference on Advanced Computing & Communication Technologies.

[3] E.Christopher Siddarth1 and K. Seetharaman2, A Cluster Based QoS-Aware Service Discovery Architecture for Mobile Ad hoc Networks, 2012 IEEE International Conference on Computational Intelligence and Computing Research.

[4] D. Karthikeyan aand M. Dharmalingam, Ant based Intelligent Routing Protocol for MANET, Proceedings of the 2013 International Conference on Pattern Recognition, Informatics and Mobile Engineering (PRIME) February, 2013 IEEE.

[5] Praveenkumar G Hoolimath, Kiran M, G Ram Mohana Reddy Department of Information, Optimized TERMITE: A Bio-inspired RoutingAlgorithm for MANET's, 2012 IEEE

[6] Vivekanand Jha, Kritika Khetarpal , Meghna Sharma, A Survey of Nature Inspired Routing Algorithms for MANETs, 978-1-4244-8679-3, 2011 IEEE.

[7] Eslam Al Maghayreh, Salam Abu Al-Haija, Faisal Alkhateeb and Shadi Aljawarneh , Bees Ants Based Routing Algorithm, 2010 International Conference on Intelligent Systems, Modelling and Simulation.

[8] L.J.G. Villalba D.R. Can˜as A.L.S. Orozco , Bio-inspired routing protocol for mobile ad hoc networks, Published in IET Communications,Received on 23rd December 2009 Revised on 30th May 2010doi: 10.1049/iet-com.2009.0826ISSN.

[9] M.M.Goswami, R.V. Dharaskar and V.M.Thakare, Fuzzy Ant Colony Based Routing Protocol For Mobile Ad Hoc Network, 2009 International Conference on Computer Engineering and Technology, 978-0-7695-3521-0/09 $25.00 © 2009 IEEE, DOI 10.1109/ICCET.2009.168

[10] A K Daniel and R Singh, Swarm Intelligence Based Multicast Routing and Bandwidth Management Protocol for AD-hoc Wireless Network Using Backpressure Restoration, 2010 IEEE.

[11] ZAFAR H., HARLE D., ANDONOVIC I., KHAWAJA Y.: 'Performance evaluation of shortest multipath source routing scheme', IET Commun., 2009, 3, (5), pp. 700–713

[12] WANG J., OSAGIE E., THULASIRAMAN P., THULASIRAM R.K.: 'HOPNET: a hybrid ant colony optimization routing algorithm for mobile ad hoc network', Ad Hoc Netw., 2009, 7, (4), pp. 690–705.

[13] DORIGO M., STU¨ TZLE T.: 'Ant colony optimization' (The MIT Press, 2004).

[14] HOSSEIN O., SAADAWI T.: 'Ant routing algorithm for mobile ad hoc networks (ARAMA)'. Proc. 22nd IEEE Int. Performance, Computing, and Communications Conf., Phoenix, Arizona, USA, April 2003, pp. 281–290

[15] LIU L., FENG G.: 'A novel ant colony based QoS-aware routing algorithm for MANETs' (Springer, Berlin, Heidelberg, 2005), ICNC, 2005, LNCS, 3612, pp. 457–466

[16] DI CARO G.A., DUCATELLE F., GAMBARDELLA L.M.: 'AntHocNet: an adaptive nature-inspired algorithm for routing in mobile ad hoc networks', Eur. Trans. Telecommun. (Special Issue on Self-organization in Mobile Networking), 2005, 16, (5), pp. 443–455

[17] DI CARO G., DUCATELLE F., GAMBARDELLA L.M.: 'AntHocNet: an ant-based hybrid routing algorithm for mobile ad hoc networks'. Proc. Eight Int. Conf. on Parallel Problem Solving from Nature (PPSN VIII), Birmingham, UK, 18–22 September 2004, (LNCS, 3242)

[18] G.A. Di Caro, F. Ducatelle, L.M. Gambardella. Swarm intelligence for routing in mobile ad hoc networks. In Proceedings of the IEEE Swarm Intelligence Symposium, pages 76–83, Pasadena, USA, June 2005. IEEE Press.

EFFECT OF TEMPERATURE ON DENSIFICATION OF Y_2O_3:SiO_2 POWDER

Rachna Ahlawat

Department of Physics, Materials Science Lab., Ch. Devi Lal University, Sirsa, Haryana (India)

ABSTRACT

Y_2O_3:SiO_2 powder was synthesized by a sol gel method, using hydrous yttrium nitrate and hydrous silicon oxide as precursors and HCl as a catalyst. The dried samples were annealed at different temperature in air using multi step scheme with a final stage of about 900°C for 6.0 hours. The samples of Y_2O_3:SiO_2 powder were obtained with high densification and well defined size and shape. Structural changes of the nano powder were investigated by XRD and TEM. Activation energy and micro stain were also calculated for the prepared samples. Almost fully dense spherical yttria nanopowder has been demonstrated with an average grain size distribution of 30 nm which are uniformly dispersed with in silica matrix.

Keywords: Nanopowder, Sol-gel Technique, Multistep annealing, XRD, TEM.

I. INTRODUCTION

For the development of powder technology, in particular, demands as a building blocks due to the increase in structural and compositional complexity so that they can be produced with ease, in abundance, at low cost and low temperature. Nano powders containing nanocrystalline rare-earth oxides (R_2O_3) and silica have been investigated widely due to their use in many fields [1-3]. The application of nanocrystalline materials as a powder feedstock for thermal spraying has been facilitated with a wide range of powder sources such as vapor condensation, combustion synthesis, thermo chemical synthesis, co-precipitation and mechanical alloying/milling and sol-gel process, etc [4-5]. Among the various powder sources, sol-gel process has the advantage of lower temperature, possibility of making a finely dispersed powder, easy to make and at low cost. Cannas et al. [6] used sol-gel method to prepare Y_2O_3:SiO_2, after thermal treatment of samples at moderate temperature T ~ 900°C (0.5 h) and high temperature 1300°C (0.5 h) in air. They found Y_2O_3:SiO_2 as an amorphous when it was sintered at moderate temperature. In another case, Xiaoyi et al. [7] used co-precipitation technique to synthesize Y_2O_3:SiO_2 samples. The prepared powder samples were thermally treated around T~800°C and their structural characterizations were demonstrated. In order to prepare powder of nanocomposites, two- and three- step sintering process has been used by many researchers [8-9].

In the light of above discussion, we have first time shown monitoring of shape, size and densification of Y_2O_3:SiO_2 powder using multi-step annealing. Using four step annealing scheme, quasi-spherical Y_2O_3 nanocrystallites has been obtained in SiO_2. In addition, we have also shown that size and crystallinity of Y_2O_3 nanocrystallites increase almost linearly with increasing the annealing temperature.

II. EXPERIMENTAL

2.1 Sample Preparation

Using sol-gel technique, the samples of Y_2O_3:SiO_2 powder was prepared. The complete description of the synthesis method has been given in our earlier publication [10]. In forthcoming subsections dried sample is named as-prepared (a) and annealed samples are designated as: (b), (c), (d) and (e) according to their respective annealing schemes as shown in the Fig. 1.

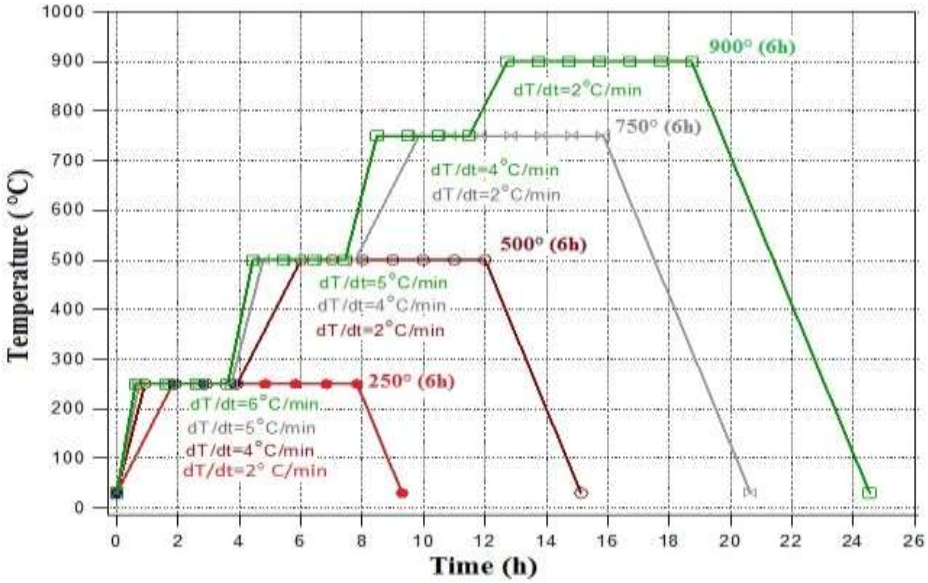

Figure 1: Schematic Diagram of Annealing Scheme

2.2 Characterizations

As-prepared and annealed samples were characterized by an X'pert Pro X-Ray Diffractometer with Cu-$k_{\alpha 1}$ radiation in the range of 5°-80° in steps of 0.017^o (40mA, 45KV) for the determination of crystalline structure of nanocomposites. Shapes, sizes and morphologies were further confirmed by HRTEM Hitachi 4500 micrograph. The samples were prepared for TEM imaging by drying aforesaid samples on a copper grid that was coated with a thin layer of carbon then analyzed using a Hitachi 4500 micrograph.

III. RESULTS AND DISCUSSION

3.1. XRD

XRD pattern of as-prepared sample (a) and the annealed samples at different conditions have been shown in the Fig. 2. The diffraction pattern of as-prepared sample (a) depicts two very strong and sharp diffraction lines centered at 2θ ~ 13.96°, 25.65° and a series of weak peaks lying between 30° to 70°. The sharp lines could be ascribed to the characteristic diffraction of yttrium nitrate hydrate (JCPDS card no. 84-2195) and silicon oxide hydrate (JCPDS card no. 82-1179). These sharp lines of dried-sample signify bulk behavior of hydrous precursor's nuclei and also suggest that the precursors have not decomposed. The XRD pattern of the sample (b) reveals that the precursor yttrium nitrate hydrate was almost decomposed which is confirmed by disappearance of its characteristics peak at 2θ ~ 13.96°. However, no significant change is evident in the characteristics peak of the precursor silicon oxide hydrate which entails that precursor was still not decomposed.

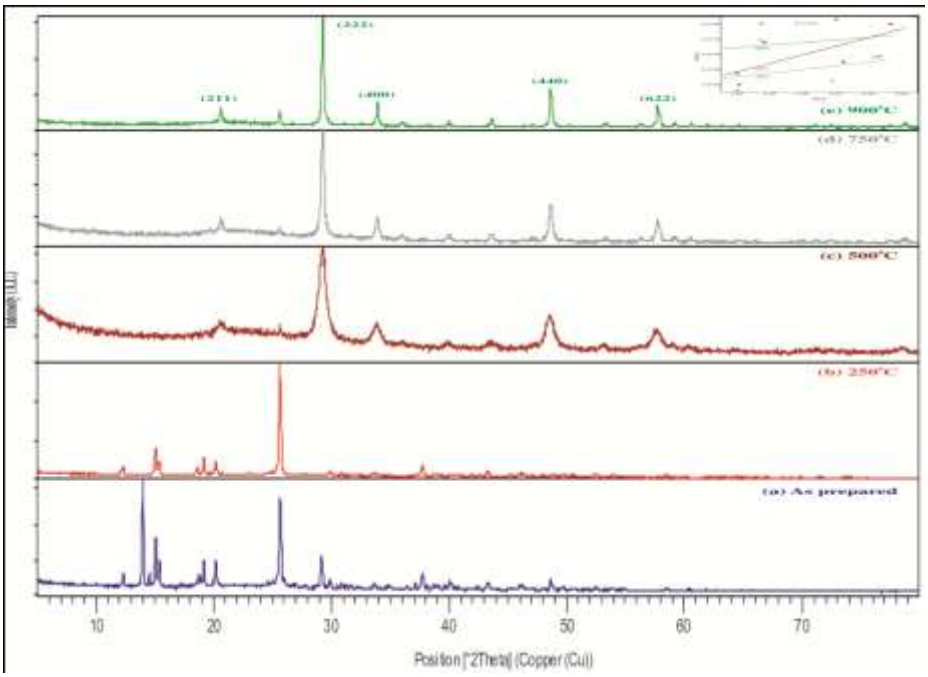

Figure 2: XRD Patterns Of As-Prepared and Annealed Samples of Y_2O_3:Sio_2 Powder

However, in diffraction pattern of sample (c), the characteristic peak of the precursor silicon oxide hydrate disappeared which implies that this precursor has been decomposed and interfacial interaction has also been started in the sample. A strong but slightly broad new peak appeared at 2θ ~ 29.25° with some weak new peaks at 2θ ~ 20.62°, 33.85°, 48.58°, 57.77° in the diffraction pattern. The occurrence of these new peaks infers the development of a new polycrystalline phase in the sample. In order to identify structure of the polycrystalline phase, "Check cell" code was run and found that plane corresponding to diffraction peaks at 2θ~ 20.62°, 33.85°, 48.58°, 57.77° could be assigned to Miller indices (211), (400), (440), (622), respectively of the cubic Y_2O_3 structure having lattice parameter a = 10.56 Å and space group Ia3 (T_h^7) [11]. Moreover, Miller indices were also confirmed by comparing the obtained Check cell data with the JCPDS card no. 41-1105. On further inspection of sample (c), a hump between 2θ~20°-26° along with a small peak centered at 2θ ~ 25.64° is clearly evident in the Fig. 2 for strengthening of vitreous silica. Furthermore, temperature was raised up to 750°C (6.0 h) by three-step annealing to examine structural changes and crystallinity of cubic Y_2O_3:SiO_2 polycrystalline powder. A significant increase in intensity and sharpness of the characteristic peaks of Y_2O_3 (JCPDS card no. 84-2195) indicates the increase in its crystallinity and size. By minute observations, one may notice a crystalline peak (2θ ~ 25.62°) emerged over the vitreous silica residual background, which can be attributed to characteristic lines of the quartz. These results give confidence that annealing conditions of sample (d) is more or less sufficient to obtain cubic Y_2O_3 nanocrystallites with a well-defined size in crystalline silica matrix. On the other hand, literature reveals a conventional heat treatment for dried Y_2O_3:SiO_2 sample at T ~ 900°C for (0.5 h) and yielded amorphous Y_2O_3:SiO_2 composites [6]. We have annealed the sample (e) by four-step annealing in which final stage annealing was done at 900°C for 6.0 hrs and found that the intensity and sharpness of the characteristics peaks have increased significantly, which infers further improvement of crystallinity and size of Y_2O_3. The XRD results suggest that the crytallinity and densification of Y_2O_3 nanocrystallites in crystalline SiO_2 matrix can be tailored by varying ramp rates and annealing temperatures.

3.1.1 Crystallite Size and Micro-Strain Calculations

The micro-strain and crystallite size produces peak broadening in the diffractogram. The crystallite size and the strain effect can be differentiated in the diffractogram. Both effects are independent and can be distinguished by the W-H plot. The W-H equation is:

$$\beta_{hkl}\mathrm{Cos}(\theta)_{hkl}=K\lambda/D+2\varepsilon\mathrm{Sin}(\theta)_{hkl} \quad \ldots(1)$$

where K is the shape factor which is 0.9 for uniform small size crystals, λ is the wavelength of X-ray, θ_{hkl} is the Bragg angle, ε is the micro-strain and *D* is average crystallite size measured in a direction perpendicular to the surface of the specimen. The graph is plotted between Sin $(\theta)_{hkl}$ and β_{hkl} Cos$(\theta)_{hkl}$ as shown in the inset of Fig. 2. From this graph, value of the micro-strain is estimated using slope of the line and found 1.41×10^{-3}, 1.19×10^{-3} and 1.05×10^{-3}, respectively for samples (c), (d) and (e). The nano crystallite size has also been calculated ~ 13 nm, 21 nm and 35 nm from the intersection along the vertical axis. In the Fig. 3, micro-strain *(right vertical axis)* versus 1/T is plotted. It was noticed that micro-strain reduces gradually with increasing annealing temperature. Moreover, influence of micro strain (ε) on peak broadening is negligibly small. Under these considerations, Williamson-Hall relation reduces to a well known Debye-Scherer's equation:

$$D=K\lambda/\beta\mathrm{Cos}\theta \quad \ldots(2)$$

The average crystallite size (*D*) of cubic Y_2O_3 was also estimated using Debye-Scherer's equation and found 10 nm, 20 nm and 33 nm, respectively for samples (c), (d) and (e). The average crystallite size estimated by the Williamson-Hall and Debye-Scherer's equation is found almost equal because influence of micro-strain in the peak broadening was very weak due to multi-step annealing.

3.1.2 Activation Energy

Crystallite growth is a crucial aspect of thermal stability of the nanocrystalline solids. Nanocrystalline materials are thermodynamically unstable due to the presence of a large fraction of interface boundaries. There is a strong tendency for nanocrystalline materials to convert to conventional coarser grain materials with fewer interfaces. Therefore, stabilization of the nanocrystalline grain structure is of critical importance.

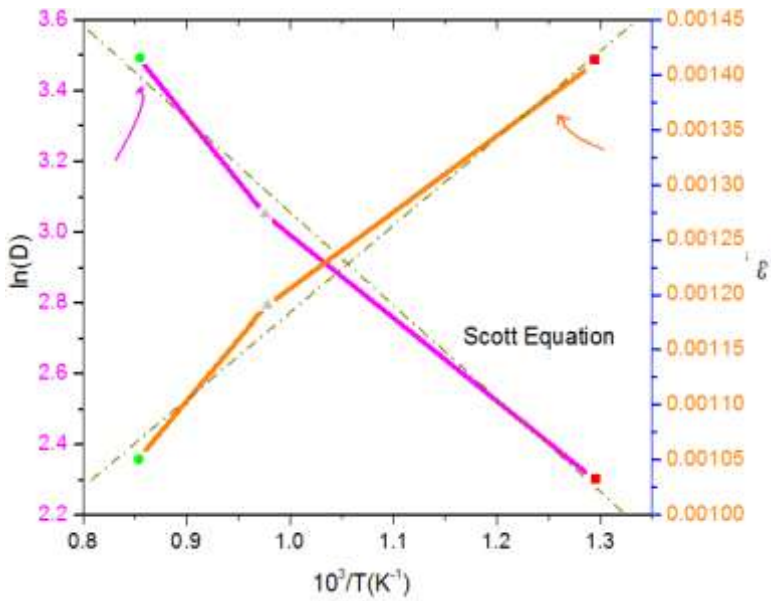

Figure 3: Variation Of Crystalline Size (Left Verticle Axis) And Micro-Strain (Right Verticle Axis) Vs. 1/T. Dotted Lines Repersent Fitting Of Data

If the growth rate of crystallite from thermal treatment is known, then using Scott relation: $D = C \exp(-E/RT)$, where C is a constant, R is the ideal gas constant; one may estimate activation energy (E) for the grain growth [12]. The activation energy value is obtained E = 25.6 KJ/mol from the slope of the straight line of plot between ln (*D*) versus 1/T as shown in the Fig. 3. It has been observed that activation energy of Y_2O_3 nanopowder is found nearly 5 times smaller than the activation energy of Y_2O_3 bulk powder [13]. In the Fig. 3, almost linear relationship between crystallites size *(left vertical axis)* and inverse of final stage annealing temperature suggests crystallite growth primarily by means of an interfacial reaction in Y_2O_3:SiO_2 composite [11]. This result suggests that crystallites size of cubic Y_2O_3 nano powder almost increases linearly with increasing annealing temperature.

3.3 Transmission Electron Microscopy

The transmission electron microscopy (TEM) of as-prepared (a) and annealed powder samples (c), (d), (e), are shown in the Fig. 4. The selected-area electron-diffraction (SAED) pattern of the individual nanoparticles was obtained (inset) to evaluate their crystalline nature.

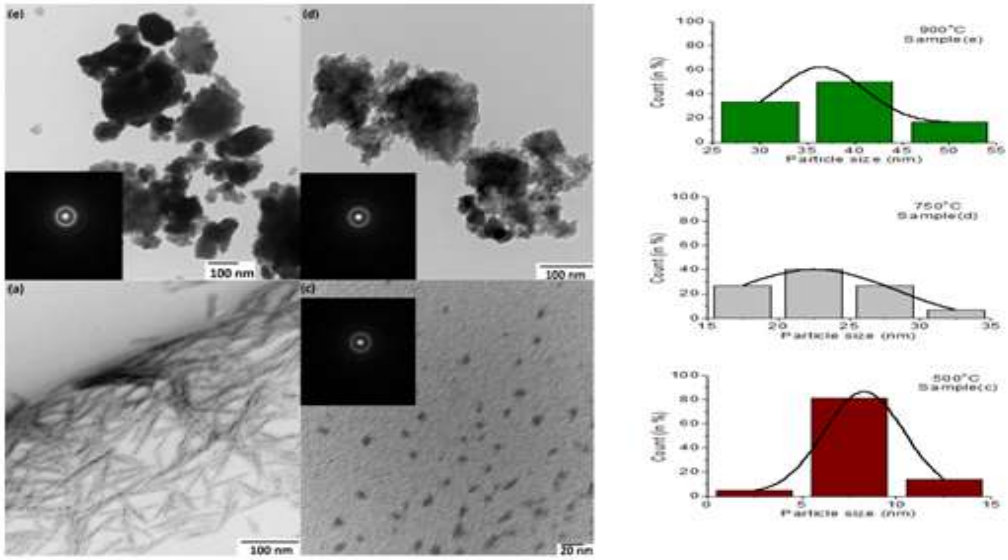

Figure 4: TEM Micrographs Of Samples: (A), (C), (D) And (E). Inset Show Slected-Area Electron Diffraction

(SAED) patter of the micrograph. Particle size distribution for (c), (d) and (e) samples has also been shown.

As expected, micrograph of samples (a & b) shows typical chain-like structure of acidic gel of precursors and confirms the results of XRD of this sample. The TEM image of sample (c) shows non-agglomerated yttria nanocrystallites of quasi-spherical shape having size ranges 8-10 nm and grain size distribution shows that nano Y_2O_3 have narrow grain size distribution in the silica matrix as shown in the Fig 4. Corresponding ring pattern of this sample indicates a weak polycrystalline nature of the sample and this result suggests that the FTIR and XRD results are in close agreement with one another.

The TEM micrograph of sample (d) illustrates coalesces of yttria nanocrystallite and resulted in bigger size (15-30 nm); among them 40 % crystallites are having their size 25-30 nm as shown in the particle size distribution. The SAED pattern of this sample verifies that the synthesized nanocrystallites have better polycrystalline nature than the sample (c). In the case of sample (e), annealing was demonstrated by a four-step program. The TEM micrograph of sample (e) depicts a densified and almost fully crystalline yttria nanopowder and its size has been

increased significantly. Histogram as shown in the Fig. 4 reveals that nearly 50 % crystallites are having size ranges 35-45 nm and the sample (e) has comparatively wider grain size distribution than that of sample (c) annealed via two-step process.

Hence it may be concluded from the TEM micrographs that crystallites growth of Y_2O_3 in crystalline SiO_2 proceeded by grain boundary diffusion mechanism while densification occurs due to grain boundary migration.

IV. CONCLUSION

Using sol-gel method Y_2O_3:SiO_2 nanocomposite was successfully obtained by multi-step annealing process. In single-step annealing, at low temperature T~ 250°C, yttrium nitrate hydrate was decomposed, while in two-step, silicon oxide hydrate was decomposed and interfacial solid-state interaction resulted in formation of Y_2O_3:SiO_2 polycrystalline powder. The crystallites were found to be 5-10 nm with quasi-spherical shape and homogenously dispersed with quite narrow size distribution in silica matrix. In three-step annealing, a significant increase in intensity and sharpness of Y_2O_3 characteristic peaks indicates increase in its crystallinity, densification and size. Four-step annealing produced almost fully crystallized with less micro-strain, stable, pure and densified, cubic-yttria nanopowder in crystalline silica matrix.

REFERENCES

[1] F. Branda in: Advances in nanocomposite: Synthesis, Characterization and Industrial applications Eds. B.S.R. Reddy, Ch 14, 2011.

[2] A. Iyer, J.K.M. Garofano, J. Reutenaur, S.L. Suib, M. Aindow, M. Gell, E. H M. Jordan, A. Gell, Sucrose-Mediated Sol–Gel Technique for the Synthesis of MgO–Y_2O_3 Nanocomposites, J. Am. Ceram. Soc. 96 (2013) 346-350.

[3] K. Ariga, J.P. Hill, M.V. Lee, A. Vinu, R. Charvet, S. Acharya, Challenges and breakthroughs in recent research on self-assembly, Sci. Technol. Adv. Mater. 9 (2008) 014109.

[4] S. Duhan, P. Aghamkar, Bhajan Lal, Effect of thermal annealing on Nd_2O_3-doped silica powder prepared by the solgel process, J. Alloys Compd. 474 (2009) 301-305.

[5] P. Aghamkar, S. Duhan, M. Singh, N. Kishore, P.K. Sen, Effect of thermal annealing on Nd_2O_3-doped silica powder prepared by the solgel process, J. of Sol-Gel Sci. and Tech. 46 (2008) 17-22.

[6] C. Cannas, M. Casu, A. Lai, A. Musinu, and G. Piccaluga, Study of the nanoparticle/matrix interactions in Y_2O_3–SiO_2 samples, Phys. Chem. Chem. Phys. 4 (2002) 2286-2292.

[7] S. Xiaoyi and Z. Yuchun, Preparation and optical properties of Y_2O_3/SiO_2 powder, Rare Met. 30 (2011) 33-38.

[8] X-H Wang, I-W Chen, Synthesis of nanocomposites, Nanomaterials Handbook, Eds. Y. Gogosti, CRC Press, 2006, Ch. 12

[9] M. Dagfinn, S.Crina, W. Ivar, A.C. Hoffmann, Sintering of 4YSZ (ZrO_2^{+4} mol% Y_2O_3) nanoceramics for solid oxide fuel cells (SOFCs), their structure and ionic conductivity, J. Eur. Ceram. Soc. 29 (2009) 2537-2547.

[10] Rachna and P. Aghamkar, Optical Materials, 36 (2013) 337.

[11] R.G. Haire, L. Eyring, Comparisons of the Binary Oxides, Handbook on the Physics and Chemistry of Rare Earths, Vol. 18, ed. by K. A. Gschneidner, Jr., L. Eyring, G R. Choppin, G. R. Lander (North-Holland, Amsterdam, 1994), Chap. 12.

[12] M.G. Scott, Amorphous Metallic Alloys, Butterworth, London, (1983), p.151.

[13] L.G. Jacobsohn, M.W. Blair, S.C. Tornga, L.O. Brown, B.L. Bennett, R.E. Muenchausen, Y_2O_3:Bi nanophosphor: Solution combustion synthesis, structure, and luminescence, J. Appl. Phys. 104 (2008) 124303-10.

DISRUPTIVE INNOVATIONS IN FINANCIAL MANAGEMENT

Reepu

Department of Management, Punjab Institute of Technology, Nandgarh, Punjab, (India)

ABSTRACT

Disruptive innovations have dramatically changed industry's product profile. There have been prevalence of such state of affairs where there is introduction of a new disrupt into the disruptive innovation or re-calibration of traditional practice or blend of preceding and new-fangled technique or embracing and hence hounding the disruption. Such disruptions fall normally under the purview of either Type I or Type II disruption. Management Education has also encountered both types of disruptive innovations. The present paper is an attempt to locate some major traditional models and disruptive innovations (of both types) like FIS, JIT etc that have completely changed the financial management outlook.

Keywords: Disruptive Innovations, Financial Management, Traditional Practices, Type I, Type II Etc.

I. INTRODUCTION

Clayton Christensen, a HBS professor, coined the term disruptive innovation which as the name suggests, is disrupting the contemporary methodology, by introducing a radical thrift of performing an activity. It landed businesses to a new landscape resulting to, more opportunities. Businesses that tend to continue with obstinate business models have normally been decimated by time. Flexible client serving model is desired. Numerous disruptive innovations have captivated the interest of many industries thus transforming the manner in which the task was conducted. So, management education has not been devoid of disruption. Financial management has its roots from the traditional stretch of time where procurement of funds was its core concern. But time revolutionized and sourcing as well as effective utilization harboured with low cost became the focal point. This time lap has been the race against imperfections. New entrants have probably prompted to disruptive innovations leading to the disequilibria in the existent states.

There prevail only two types of disruptions (a) Type I disruption erupts by indulging non-targeted customer segment or non-consumers into a new sway of thought. It involves sufficing the need of those, for whom nobody has paid the heed earlier. For e.g. accounting software Quicken is highly appreciated by smaller businessmen, because the former products were highly complicated resulting into its non-usage by that segment. (b) Type II disruption on the other hand, is disrupting the traditional product's usage by offering a new one driven by more efficacies. For e.g. Discount retailers like Walmart disrupted the pathway of traditional sellers through its discount models. The above type I and II disruption can be delineated with the help of the following-

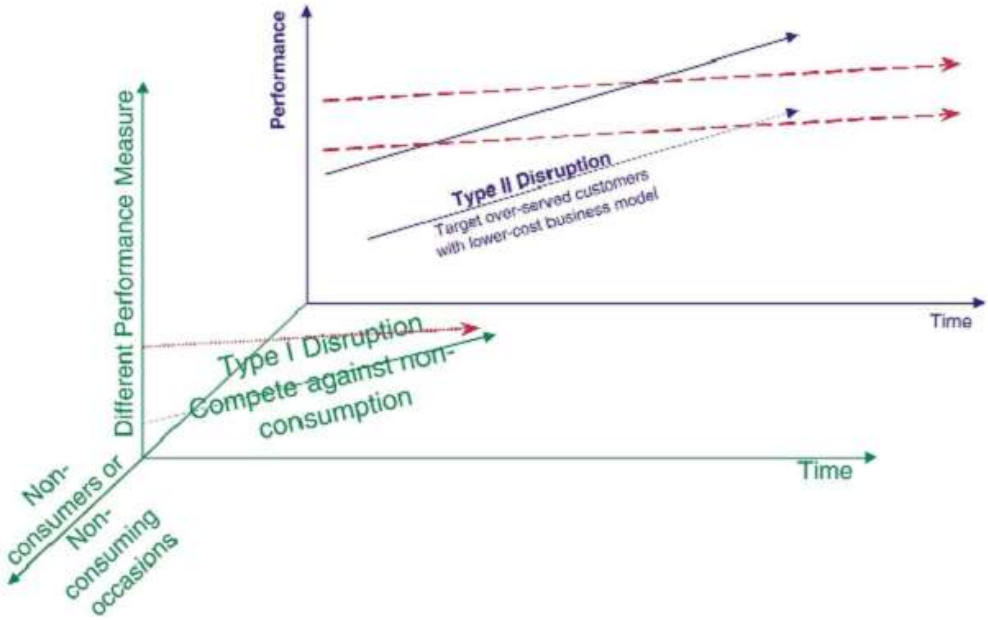

Fig 1: Two Types of Disruptions

II. REVIEW OF EXISTING LITERATURE

King, A.A and Tucci, C.L (2002) proclaimed that several times existing players have played the role of disruptors. Various disruptors include IBM for personal computers, HP for Inkjet printers, Sony for walkmans and several more. According to them such innovations came to existence due to consistent efforts as well as learning's from the past. Christensen, C.M and Raynor, M.E (2003) found that disruptive innovation can be categorised into low-end and new-market. Low end disruptive innovations target those customers who have already been over-served by the products of varied industries while new market disruptive innovations target new profiles or those who have been least served. Govindarajan, V and Kopalle, P.K (2006) conducted several statistical tests, confirmatory and exploratory factor analysis to check the soundness of disruptiveness scale and found it to be a successful measure. They believed that disruptive innovation must offer more valuable propositions for capturing new market. Low Price offerings will tempt the price sensitive customers. Markides, C. (2006) researched that there is huge difference between business model and technological innovations. He persist the use of disruptive innovation rather than disruptive technology. Hang et al (2009) discussed the theoretical imperatives of disruptive innovation. Further the various literatures are analysed from internal, external, marketing and technology perspectives so as to enhance disruptive innovations from this vicinity too.

III. MAJOR TRADITIONAL MODELS AND DISRUPTIVE INNOVATIONS

3.1 Following Are the Traditional Models and the Disruptive Innovations of Type I-

3.1.1 Accounting - Manual Prodigy

Accounting pertains as valuable input contributor towards financial decision making. Accounting facilitates recording of information in a systematic manner through which it can be easily communicated to stakeholders and hence protecting their interests as well as meeting the legal formalities. Recording of information sprinkled with cost cutting, is its principle of huge essence. Relationship between finance and accounts can be described as-

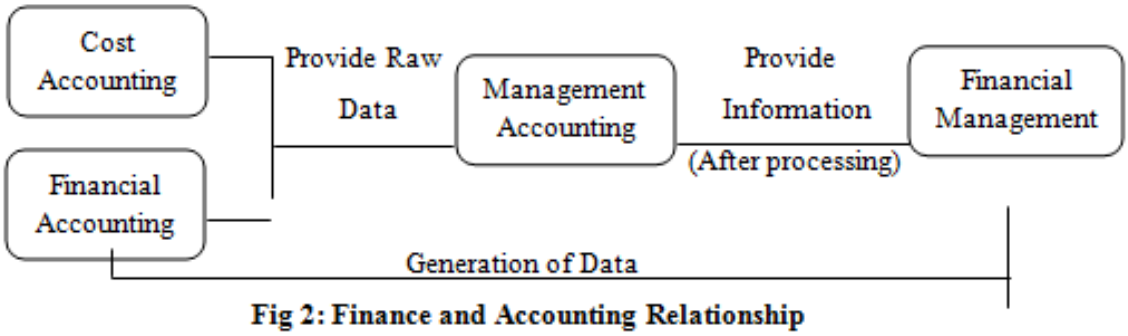

Fig 2: Finance and Accounting Relationship

Therefore, cost and financial accounting provides constructive information for financial planning and supportive framework for preparation of financial statements.

Disruptive Innovation: - Financial Information System (FIS) presents dynamic modules to encompass the functionalities of finance. Various modules are: - (a) General Ledger- The principal book constituting final entries upholds account related information of all assets (excluding debtors), liabilities (excluding creditors), capital, expenses and revenue. Module adds more utility by consolidating the ledger information of multiple SBUs of varied format into the central database of the group so, adding more user-friendliness and comprehensiveness. (b) Accounts Payable- It comprises of the various outstanding amounts payable within one accounting period out of current assets. FIS aids in managing and controlling payables by tracking the available cash, discounts and payment due dates. Database maintains the historic entries of supplies, prices paid off and balance entries (if any) thereby assisting in managerial decision making. It ensures integrity among the accounting periods by necessitating information input for the current period. Further, Electronic Data Interchange automatically computes the due and discount dates as well as their amounts resulting to potential savings. Moreover automatic vouchers for periodic disbursements like rent etc will evoke for monthly payments. (c) Accounts Receivables- Firms often sell few items on credit to its frequent buyers, so information about receivables for accommodating sound collection is required. FIS entails up-to-date reports briefing about the customer dues and payments made. Firm even employs credit checks to entitle the exceeding limit or number of days. Summary of sales commission eases the employee performance management. (d) Transaction Accounting- FIS allows the processing of alike natured transactions under one roof delivering rapid upshots. Moreover duplication of entries or entries of dubious nature is easily captured which makes the system more efficient. Further, an entry is to be made only once and all the relevant sub-systems (in demand of the common entry) will automatically be updated with it, whenever required. Interspersed with adequate controls the system hence will ensue to valid information. All the transactions made can easily be fed into auditing through a network of auditors and accountants drafting information in more legitimate terms.

Information integration through the medium of modules is of huge significance. For instance whenever an account payable transaction is made, the transaction accounting automatically processes it updates vendor information and posts the entry to the general ledger also, thereby leading to error deduction and efficiency addition. In addition to this, Online Analytical Processing creates multi-dimensional data view which enables manager to view information from multifaceted perspectives fostering analytical proceedings through flexible system.

Software buttress for financial management have provided solutions to the company who tend to streamline information on client-server model tendering the needs of small business owners also, who were earlier out of the purview.

3.1.2 Stock Broking- Manual Prodigy

Full service brokers endow customers with advisory services, portfolio management and administration. Advisory service include designing appropriate strategy for meeting investor's objective, portfolio management involves management of various stocks etc in resonance to the strategy formulated and administration refers to all the clearing, trading and reporting to effectively manage portfolio. Brokers, after receiving orders from customers through telephones, enter the customer orders into their exchange linked systems and hence charges for the various services rendered.

Disruptive Innovation: - Discount Brokers acknowledge orders of stocks, forex, mutual funds etc. directly through internet and even allows to trade with other investors over Electronic Communication Network (ECN). Moreover, stock selection can be done easily due to the availability of online research instruments, real time quotes etc. Discount brokers can filter their search too, thus accepting those only whom they feel fit or may enforce creation of resourceful investor network only. Such a system provides trading platform to those who wish investing lesser amount of funds or those who cannot afford the brokerage fees or for whom market has been completely inaccessible. Trading, now-a-days has been just a click away, so investors may pour in funds, as advised by their government registered discount broker and gain maximum profit.

3.2 Traditional Models and Disruptive Innovations of Type II

3.2.1 Portfolio Risk Measurement Model

Capital Asset Pricing Model enables the investor to determine the risk-return paradigm of the portfolio. It facilitates information about associated risk profile, the expected return as well as price of an asset. Model states that only systematic risk is accountable to portfolio. It works with the following assumptions only (Sharpe's way) : - (a) No transaction cost is associated with capital market. (b) Investors select only that portfolio which rewards them with higher return. (c) Assets are not indivisible. (d) Analogous estimates of variance, co-variance and mean prevail with all investors. (e) Short selling is permitted. (f) Infinite borrowing and lending at risk free rate of return is acceptable. Therefore, the Expected Rate of Return = Risk Premium + Risk free ROI, where Risk Premium is the difference between diversified portfolio's return and risk free return.

CAPM equation is:

$$K_e = R_f + B_i (R_m - R_f) \quad (1)$$

Where, K_e is the required or expected return (cost of equity capital), R_f is the risk free rate of return, B_i (termed as Beta risk) is quantifier of market risk and R_m is the market linked portfolio return.

So, CAPM employs only market risk for computing the asset price, which questions its empirical evidence.

Disruptive Innovation: - Fama-French disrupted the traditional perspective of linking returns as well as pricing with only systematic risk, by proposing a three factor model which quoted that return is a function of following three valuables - (a) Size- Small Cap tend to pose extra risk as they behave separately than Large Cap and normally deliver more returns. (b) Value- Companies who pose for high dividend, low price in comparison to

book value and less earning rate of growth may generate higher returns in longer term. (c) Beta- is a measure of systematic risk. Whenever, beta of a portfolio is more than market, risk quotient will always be more. Hence, Three Factor Model equation becomes:

$$K_e = R_f + B_{im} (R_m - R_f) + B_{is} (R_s - R_b) + B_{ih}(R_h - R_l) \quad (2)$$

Where, $R_s - R_b$ depicts the difference between the returns expected from small cap and large cap and $R_h - R_l$ is the difference between the returns of high as well as low book to market ratio. So, in the real world investors are concerned with several risks rather than orienting towards systematic only.

3.2.2 Inventory Management Techniques

Every organization makes gigantic investments in inventory. It constitutes of Raw Material, Work in Progress, Consumables, Finished Goods and Spares. Management of this inventory is vital as it is a significant component of current assets. Various tools are employed to suffice this purpose which comprises of EOQ, ABC analysis, Aging Schedule of Inventory etc. A brief outlook of these is presented as below:-

(a) EOQ (Economic Order Quantity) - is the quantity that should be ordered once as it is economically viable. It is calculated as:

$$EOQ = [(2* \text{ Annual Consumption}*\text{Ordering Cost})/ \text{ Carrying Cost}]^{1\backslash 2} \quad (3)$$

Where ordering cost includes the various costs of placing an order like expenses of carriers, inspections etc, while carrying costs (also called holding cost) is the cost for holding the inventory for a longer time period like cost of warehousing, material spoilage etc.

(b) ABC analysis classifies the inventory under three categories A, B and C. It is believed that nearly 10% items of the organizations are such that they contribute towards 70% of usage and hence are categorized as A class. Nearly 20% of items are such that they tend to fulfil only 20% of usage so they are categorized in B class. Category C consists of 70% items but they contribute only 10% utility.

(c) Aging Schedule of Inventory- This method manages inventory with the help of its aging i.e. more the age of inventory, more emphatic control it require since it is a slow moving inventory.

Disruptive Innovation: - Just In Time, an outcome of Toyota Production System, is a disruptive innovation of managing inventory because it demands zero level inventories inside the organization so as to annihilate waste from every process, in contrast to traditional set ups which require stocking up of inventory to meet uneven demand levels and hence gauging for heavy investments. Zero level eradicates the redundant costs like handling, inspection costs etc. But it also advocates of superior relationships with suppliers as being the solo entity who can furnish inventory at the requisite time. Further petite set up and processing time is desired. Judicious use of time to deliver consignments both inside and outside the organization is another mandate. JIT forbids of prior planning and forecasting rather production in need forms the sound basis. Reducing breakeven time to zero is JIT's another objective as it will lead to smooth production. Moreover recurrent production runs are required for JIT. Hence, accurate quantities will be procured at accurate time.

IV. CONCLUSION

Outstanding intellects behind disruptive innovations have generated smarter methodology to furnish a task, leading to constructive change in the financial management manoeuvre. Tremendous improvements over traditional models have made them more realistic and viable. Disruptions have introduced intelligent way of

targeting more, low end entities leading to reassurance of their demands. In context of this disruption, three factor model have innovatively disrupted the path of capital asset pricing model, and just in time into traditional inventory model. Several other disruptions have unwrapped product/service offerings to a subset of market which has not been tapped before. Financial Information System, Discount Broking are the innovations which have actively disrupt clumsy traditional methods and outperformed by making offerings to those for which they were completely inaccessible.

REFERENCES

[1] King, A.A. and Tucci, C.L., Incumbent entry into new market niches: the role of experience and managerial choice in the creation of dynamic capabilities, Management Science, 48(2), 2002, 171-186.

[2] Christensen, C.M. and Raynor, M.E., The Innovator's Solution: Creating and Sustaining Successful growth, Boston, M.A: Harvard Business School Press, 2003.

[3] Govindarajan, V. And Kopalle, P.K., The usefulness of measuring disruptiveness of innovations ex post in making ex ante predications, Journal of Product Innovation Management, 23, 2006, 12-18.

[4] Markides, C., Disruptive Innovation: in need of better theory, Journal of Product Innovation Management, 2, 2006, 19-25.

[5] Hang et al, A Reflective Review of Disruptive Innovation Theory, International Journal of Management Reviews, 2009, 1-21.

STUDY AND SIMULATION OF DIGITAL MODULATION SCHEMES USING BER CALCULATION

Dr. Saroj Choudhary[1], Dixit Dutt Bohra[2]

[1]*Associate Professor, Department of Applied Science, Jodhpur National University, Jodhpur, Rajasthan, (India)*

[2]*Department of Electronics & Communication Engineering, MBM Engineering College, JNVU, Jodhpur, Rajasthan, (India)*

ABSTRACT

With the increasing demand in communication, it has become necessary to give better and efficient service to users by using better technique. This paper calculates the bit error rate for digital modulation schemes such as Binary Phase Shift Keying (BPSK). By Choosing a reliable modulation scheme and better coding technique the enhancement of the performance can be obtained in transmitter and receiver of the system. Simulated result is shown to analyse the performance of this system by using additive white Gaussian noise channel (AWGN). From analysis of modulation techniques, the system could use more appropriate modulation technique to suit the channel quality, thus we can deliver the optimum and efficient system parameters. LabVIEW has been used for simulation.

Keywords: AWGN, BER, BPSK, LabVIEW.

I INTRODUCTION

The history of communication gives us insight into the way it influenced the development of civilization and still exerts an influence on modern societies. Communication can be defined simply as 'sending and receiving messages', or 'the transmission of messages from one person to another'. Effective communication occurs only when the receiver understands the exact message sent by the transmitter. **[17]** A communication system is made up of devices that employ one of two communication methods (wireless or wired), different types of equipment (portable radios, mobile radios, base/fixed station radios, and repeaters), and various accessories (examples include speaker microphones, battery eliminators, and carrying cases) and/or enhancements (encryption, digital communications, security measures, and interoperability/networking) to meet the user needs. In the series of communication methods, one of them is Wireless communications. It has become one of the fastest growing areas in our modern life and creates enormous impact on nearly every feature of our daily life. A tremendous technological transformation during the last two decades has provided a potential growth in the area of digital communication.

Living in the era of communication everything may be video, audio or any information in the form of electrical signal is termed as data and there is an enormous requirement of data transfer between two or more point through the world wide web, every moment of the clock, which is a big threaten to the existing communication systems because of the problems like spectral congestion, severe adjacent & co-channel interference problems and noise corrupted data reception etc. This has resulted in serious need for the research work all around the world for the development of the communication systems which can handle the above said problems, where each aspect of the communication systems is dealt with the development of new encoding techniques, modulation techniques, possibilities for newer transmission channels and off course the demodulation and decoding techniques. **[7]** The next generation of wireless communication systems faces the demand for increased data rates, higher mobility, larger carrier frequencies, and more link reliability. Wireless channels are characterized by fading, multipath, limited bandwidth, and frequency and time selectivity which make system design a challenge. It is therefore crucial to have an understanding of the behavior of wireless channels in order to know their performance limits and to be able to design efficient communication systems for them. This dissertation considers the analysis of the performance of digital communication systems with different coding and modulation schemes.

Although digital communication is much better than the analog communication, still it has certain issues that need to be addressed. Especially when it comes to wireless communication, one of the major research considerations becomes the effect of multipath propagation. A thorough analysis is necessary for strategic planning of any system design by doing comparative study of different modulation techniques via different multipath communication channels. To study and draw the graph in terms BER versus Eb/No in multipath communication channels for modulation schemes. Therefore, understand the system could go for more suitable modulation technique to suit the channel quality and can suggest better modulation schemes. **[3]**

II DIGITAL MODULATION AND CHANNEL SCHEMES

The purpose of any digital communication system is to transmit data from an information source to an information sink. At a minimum, a baseband waveform must be constructed from the symbols making up the information. Some media, such as coaxial cable, can propagate baseband waveforms with no further manipulation required. For wireless transmission, on the other hand, baseband waveforms are impractical for several reasons. First, the antenna size necessary to transmit an electromagnetic wave is inversely proportional to the wave's frequency. Therefore, shifting the baseband waveform to a higher frequency allows for a smaller antenna. For many mobile devices, this results in a carrier frequency on the order of 1 GHz. Second, multiple transmitters operating at the same frequency generally interfere with each other. By assigning each transmitter a unique portion of the electromagnetic spectrum, multiple transmitters can operate without interference. This is called frequency-division multiple access. The translation of a baseband waveform to a higher frequency is accomplished by manipulating the features of a sinusoidal wave at that frequency. This process is called bandpass modulation. In general the four different modulation schemes: amplitude, frequency, phase and code modulation are possible. Well known examples of high frequency carrier signals are: AM radio is 550-1600 KHz, FM radio is 88 MHz-108 MHz, TV is 52-88 MHz (channels 1-6), 174-216 MHz (channels 7-12) and 470-900 MHz (UHF)

microwave and satellite signals are of the order of several GHz infra red fiber optic signals are of the order of 200-300 THz.

2.1 Digital Modulation

After the conversion of an Analog signal to digital by sampling, different types of digital modulation schemes can be achieved by the variation of different parameter of the carrier signal. For example the Amplitude variation gives BASK, Frequency variation gives BFSK and the Phase variation gives BPSK. Also sometimes a combinational variation of this parameter is done to generate the hybrid modulation technique viz. a combinational variation of Amplitude and Phase Shift Keying (APSK). Many more digital modulation techniques are available and can also be designed depending upon the type of signal and the application. Thus a better digital modulation technique is to be thought over by the designer which has an ability of exploiting the available transmitted power and the bandwidth to its full extent. **[8]** The choice of digital modulation scheme will significantly affect the characteristics, performance and resulting physical realization of a communication system. There is no universal 'best' choice of scheme, but depending on the physical characteristics of the channel, required levels of performance and target hardware trade-offs, some will prove a better fit than others. Consideration must be given to the required data rate, acceptable level of latency, available bandwidth, anticipated link budget and target hardware cost, size and current consumption.

In digital communications, the modulation process corresponds to switching or keying the amplitude, frequency, or phase of the carrier in accordance with the incoming digital data. Three basic digital modulation techniques are:

- Amplitude-shift keying (ASK) - special case of AM
- Frequency-shift keying (FSK) - special case of FM
- Phase-shift keying (PSK) - special case of PM

In binary signaling, the modulator produces one of two distinct signals in response to 1 bit of source data at a time. If all the above used as in form of Binary then it will be called BASK, BFSK and BPSK.

2.1.1 Binary Phase Shift Keying (BPSK)

BPSK (also sometimes called PRK, Phase Reversal Keying, or 2PSK) is the simplest form of phase shift keying (PSK). In binary phase shift keying (BPSK) the transmitted signal is a sinusoid of fixed amplitude. It uses two phases which are separated by 180° and so can also be termed 2-PSK. **[16].** Binary Phase Shift Keying (BPSK) modulation, the simplest and most robust of all techniques, the signal shifts the phase of the waveform to one of the two states, either zero or π. Its constellation diagram is shown in figure 3.4 with in-phase and quadrature axes named as I and Q, respectively. It is only able to transmit 1 bit/symbol in this case and so this is considered to be a disadvantage when using high data-rate systems with limited bandwidth.

For transmission of '1':

$$S_1(t) = \sqrt{\frac{2E_b}{T_b}}\cos(2\pi f_c t) \quad (1)$$

For Transmission of '0':

$$S_2(t) = \sqrt{\frac{2E_b}{T_b}}\cos(2\pi f_c t + \pi) \quad (2)$$

Where, T_b is bit duration, f_c is carrier frequency, E_b is transmitted signal energy per bit.

In another way, it can be understood as a binary level digital modulation scheme of phase variation that has two theoretical phase angles, +90° and -90°. It is immune to noise and interference therefore it improves BER performance. Each modulation symbol represents a single phase. The bit error rate (BER) of BPSK in AWGN can be calculated as:

$$P_b = Q\left(\sqrt{\frac{2E_b}{N_0}}\right) \quad (3)$$

Or

$$P_b = \frac{1}{2}erfc\left(\sqrt{\frac{2E_b}{N_0}}\right) \quad (4)$$

Since there is only one bit per symbol, this is also the symbol error rate. The differential phase shift keying (DPSK) is a modification of BPSK. [**1**]

2.1.2 Quadrature Phase Shift Keying (QPSK)

Quadrature Phase-shift Keying (QPSK) is a widely used method of transferring digital data by changing or modulating the phase of a carrier signal **[30].** A four-level (4-ary) PSK is called Quaternary Phase Shift Keying (QPSK), and uses four points on the constellation figure 3.6. The signal shifts the phase to one of four states and so QPSK can transmit 2 bits/symbol as we see from the diagram as well. When applying Gray coding each adjacent symbol only differs by one bit. The QPSK uses four phases at 0°, 90°, -90° and 180 degrees. It gives high spectral efficiency and it is more efficient than BPSK because it uses two symbols at a time for modulation. Both BPSK and QPSK are power efficient in same way but QPSK is more bandwidth efficient than BPSK. The probability of bit-error for QPSK is the same as for BPSK:

$$P_b = Q\left(\sqrt{\frac{2E_b}{N_0}}\right)$$

When QPSK is compared to that of BPSK, QPSK provides twice the spectral efficiency with the same energy efficiency. However, in order to achieve the same bit-error probability as BPSK, QPSK uses twice the power (since two bits are transmitted simultaneously). The symbol error rate is given by:

$$P_s = 1 - (1 - P_b)^2$$

$$= 2Q\left(\sqrt{\frac{E_s}{N_0}}\right) - \left[Q\left(\sqrt{\frac{E_s}{N_0}}\right)\right]^2$$

If the signal-to-noise ratio is high (as is necessary for practical QPSK systems) the probability of symbol error may be approximated:

$$P_s \approx 2Q\left(\sqrt{\frac{E_s}{N_0}}\right)$$

The Euclidean distance between any two signal points in the constellation is:

$$d_{min} = \|s_m - s_n\| = \sqrt{2E_s\left(1 - \cos\frac{2\pi(m-n)}{M}\right.}$$

The minimum Euclidean distance is

$$d_{min} = \sqrt{2E_s\left(1 - \cos\frac{2\pi}{M}\right)} = 2\sqrt{E_s}\sin\frac{\pi}{M}$$

In the case of PSK modulation, the error probability is dominated by the erroneous selection of either one of the two signal points adjacent to the transmitted signal point. Consequently, an approximation to the symbol error probability is

$$P_{MPSK} = 2Q\left(\frac{\frac{d_{min}}{2}}{\sqrt{\frac{N_0}{2}}}\right) = 2Q\left(\sqrt{2E_s}\sin\frac{\pi}{M}\right)$$

III CODING AND CHARACTERISTICS

The aim of communications is to transmit the information which is usually unknown to the receiving end in an accurate and quick manner. When data go through the communication channels, there might be the loss or some distortion of the information. Just like two speakers talking on the phone. If one does not catch the other's words, s/he may guess the ambiguous part of information by the tones and by the things talked about previously etc, or s/he could ask the other one to repeat that part. These methods to deal with uncertain words imply the human's

language system of error correction in communications. In the data communications, we could also apply similar various methods of coding to solve these problems. Coding and modulation provide the means of mapping information into waveforms such that the receiver (with an appropriate demodulator and decoder) can recover the information in a reliable manner. **[23]**

In wireless, satellite, and space communication systems, reducing error is critical. When a message is transmitted, it has the potential to get scrambled by noise. This is certainly true of voice messages, and is also true of the digital messages that are sent to and from computers. Now even sound and video are being transmitted in this manner. By a digital message, we mean a sequence of 0's and 1's which encodes a given message. What we will seek to do is to add more data to a given binary message that will help to detect if an error has been made in the transmission of the message; adding such data is called an **error-detecting code**. We will also try to add data to the original message so that we can detect if errors were made in transmission, and also to figure out what the original message was from the possibly corrupt message that we received. This type of code is an **error-correcting code**. High bit error rates of the wireless communication system require employing various coding methods on the data transferred. Codes are used for data compression, cryptography, error-correction and more recently also for network coding. Error control coding theory has been the subject of intense study since the 1940s and now being widely used in communication systems. **[18]**. Codes are studied by various scientific disciplines—such as information theory, electrical engineering, mathematics, and computer science- for the purpose of designing efficient and reliable data transmission methods. This typically involves the removal of redundancy and the correction (or detection) of errors in the transmitted data. Burst Error (contiguous errors in the bit stream) is a common occurrence in digital communication systems, broadcasting systems and digital storage devices. Many mechanisms have devised to mitigate this problem. Forward error correction is a technique in which redundant information is added to the original message, so that some errors can be corrected at the receiver, using the added redundant information.

There are essentially two aspects to coding theory:

- Data compression (or, source coding)
- Error correction (or channel coding)

3.1 Source Coding

Whether a source is analog or digital, a digital communication system is designed to transmit information in digital form. Consequently the output of the source must be converted to a format so that it can be transmitted digitally. This conversion of the source output to a digital form is generally performed by the source encoder whose output may be assumed to be a sequence of binary digits. Optimum coding aims to match the source and the channel for maximum reliable information transfer. The coding process involves two distinct operations namely encoding and decoding. The source encoder/decoder units match the source to the equivalent noiseless channel, provided that the source information rate falls within channel capacity. Source encoding attempts to

compress the data from a source in order to efficient transmission. This practice is found every day on the Internet where the common Zip data compression is used to reduce the network load and make files smaller.

3.2 Channel Coding

The aim of communications is to transmit the information which is usually unknown to the receiving end in an accurate and quick manner. When data go through the communication channels, there might be the loss or some distortion of the information. Just like two speakers talking on the phone. If one does not catch the other's words, s/he may guess the ambiguous part of information by the tones and by the things talked about previously etc, or s/he could ask the other one to repeat that part. These methods to deal with uncertain words imply the human's language system of error correction in communications. In the data communications, we could also apply similar various methods of error-correcting to solve these problems. Channel coding refers to the class of signal transformations designed to improve communications performance by enabling the transmitted signals to better withstand the effects of various channel impairments, such as noise, interference and fading. Channel coding for error detection and correction helps the communication system designers to reduce the effects of a noisy transmission channel **[18]**. In this information age, there is an ever increasing necessity not only for speed, but also for accuracy in the storage, retrieval and transmission of data. Imperfect channels or media through which messages are transmitted cause errors in the received messages. Channel coding is a technique using which these errors can be detected or even corrected. Error correcting codes offer a kind of safety net – the mathematical insurance against the vagaries of an imperfect communication channel. Channel encoding, adds extra data bits to make the transmission of data more robust to disturbances present on the transmission channel. A typical music CD uses the Reed-Solomon code to correct for scratches and dust. In this application the transmission channel is the CD itself. Cell phones also use coding techniques to correct for the fading and noise of high frequency radio transmission. Data modems, telephone transmissions, and NASA all employ channel coding techniques to get the bits through, for example the turbo code and LDPC codes**.** The following are the important aspects of channel coding also known as error control coding making use of the structured sequences.

- It is possible to detect and correct errors by adding extra bits called error check bits or parity check bits to the message bit stream. Because of the additional bits, not all bit sequences will constitute bonafide messages.
- It is not possible to detect and correct all errors.
- Addition of extra bits reduces the effective data rate through the channel. Quantitatively, the rate efficiency of a coding scheme is defined as rb/rc.

Forward error correction (FEC) coding significantly improves the performance of communications systems. Forward Error Correction **(**FEC) encoding schemes can be classified into two structural types linear block codes and convolutional codes. It analyzes the following three properties of a code – mainly: Code word length, Total number of valid code words, the minimum distance between two valid code words, using mainly the Hamming distance. Bit rate is the frequency of a system bit stream. The symbol rate is the bit rate divided by the number of

bits that can be transmitted with each symbol. Symbol rate is sometimes called baud rate. Note that baud rate is not the same as= bit rate. These terms are often confused. If more bits can be sent with each symbol, then the same amount of data can be sent in a narrower spectrum. This is why modulation formats that are more complex and use a higher number of states can send the same information over a narrower piece of the RF spectrum. SNR is defined as the ratio of a signal power to noise power and it is normally expressed in decibel (dB). The mathematical expression of SNR is

$$SNR = 10\log_{10}\left(\frac{Signal\ Power}{Noise\ Power}\right)dB$$

Performance of Error correcting codes for a complete system analysis includes finding the reliability of coding and decoding circuits as this plays a significant role in undetected errors. **[14]**. It is proved in **[10]** that for every SNR values the BER of BPSK modulation is observed to be closer to the theoretical value and hence BPSK modulation is better than QPSK modulation in both channels.

IV SIMULATION PLATFORM AND RESULT

The Simulation platform LabVIEW is chosen for the work. Some of the detail and advantages are given in this chapter to get the brief idea about the software and its advantages.

4.1 LabVIEW & Contrive

LabVIEW (**Lab**oratory **V**irtual **I**nstrument **E**ngineering **W**orkbench) is a graphical programming environment which has become prevalent throughout research labs, academia and industry. It is a powerful and versatile analysis and instrumentation software system for measurement and automation. Its graphical programming language called *G programming* is performed using a graphical block diagram that compiles into machine code and eliminates a lot of the syntactical details. LabVIEW offers more flexibility than standard laboratory instruments because it is software based. Using LabVIEW, the user can originate exactly the type of virtual instrument needed and programmers can easily view and modify data or control inputs **[12]**. The popularity of the National Instruments LabVIEW graphical dataflow software for beginners and experienced programmers in so many different engineering applications and industries can be attributed to the software's intuitive graphical programming language used for automating measurement and control systems. LabVIEW programs are called virtual instruments (VIs), because their appearance and operation imitate physical instruments like oscilloscopes. LabVIEW is designed to facilitate data collection and analysis, as well as offers numerous display options. With data collection, analysis and display combined in a flexible programming environment, the desktop computer functions as a dedicated measurement device. LabVIEW contains a comprehensive set of VIs and functions for acquiring, analyzing, displaying, and storing data, as well as tools to help in troubleshooting the code.

4.2 Simulation Result

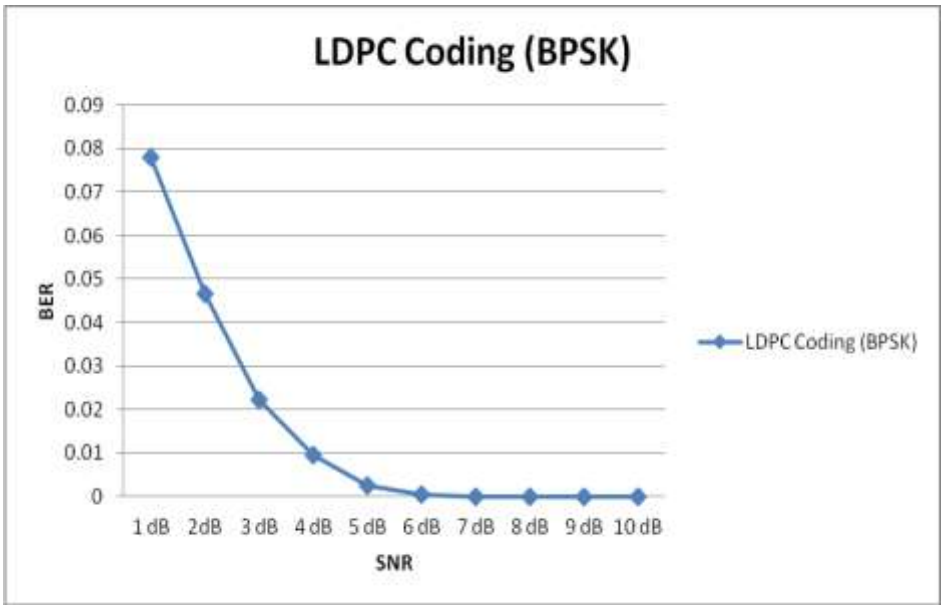

Fig. 1 BER v/s Eb/N0 for BPSK

Result shows that BER performance analysis of LDPC coding and modulations over AWGN channel. As per figure, Performance of BPSK modulation with LDPC coding is best over AWGN channel.

V CONCLUSIONS

The paper presents, error performance of two modulation techniques in AWGN channel are analysed and BER is calculated. Based on numerical calculation the BER of BPSK is graphically plotted. Use of the system appears to be very suitable for testing of new principles in the channel coding ambit without any need for a constant upgrading of hardware components and also without any customer-vendor cooperation in terms of software modifications. The software used is LabVIEW 2011. This software offers us various libraries which are suitable for channel coding decoding and performance analysis. For the experiments, we have been used the BPSK and modulation schemes that was implemented right into the assembled transmission chain with LDPC coding. The real measurements have achieved the results which have satisfied us. According to the work, a performance of different modulation techniques and channel coding is analysed on the basis of BER over AWGN channel. As per the analysis of digital modulation techniques, we can say BPSK gives better performance over AWGN channel. Also we have limitation to increase E_b/N_0 ratio. Hence, for a fixed value of E_b/N_0, we have to use some kind of coding to improve quality of the transmitted signal.

REFERENCES

[1] Tambakhe S R., Thakare Ajay P. "Design and Simulation of Mathematical Models- An DSP and Digital Communication Based Approach", *International Journal of Engineering Research and Applications*, ISSN: 2248-9622, Volume 4, Issue 4, Version 8, April 2014, pp.43-49.

[2] Sukumaran Lakshmy, Dharani K.G., "Bit Error Rate Testers-A Study", *International Journal of Engineering Research and Applications*, ISSN: 2248-9622, Volume 4, Issue 4, Version 8, April 2014, pp.122-125.

[3] Fating Pooja P., Ashtankar Pankaj S., "Comparative Study of Different Modulation Techniques for Multipath Communication Channel", *Proceedings of 4th SARC International Conference, Nagpur, India*, ISBN: 978-93-82702-70-2 March 30th, 2014

[4] Ghosh Sutanu, "Performance Analysis on the Basis of A Comparative Study between Multipath Rayleigh Fading and AWGN Channel in the Presence of Various Interference", *International Journal of Mobile Network Communications & Telematics (IJMNCT)*, Volume 4, Number.1, February 2014.

[5] Pandey Ashish, Singh Sarala et.al, "Comparative Study of Different Modulation Technique in Chaotic Communication", *International Journal of Scientific Research Engineering & Technology (IJSRET)*, Volume 2, Issue 11, February 2014, pp 738-743.

[6] Kumar Rajesh, Prasad Ganga, et.al, "Performance Analysis of Digital Modulation, Bit Dilation and Signal Level through AWGN Channel", *International Journal of Engineering Science and Innovative Technology (IJESIT)*, Volume 3, Issue 1, January 2014.

[7] Pandey Rashmi, Pandey Kuldeep "An Introduction of Analog and Digital Modulation Techniques in Communication System", *Journal of Innovative trends in Science, Pharmacy & Technology*, Volume 1(1), 2014, pp. 80-85.

[8] Kanmani B, "Digital Communication Using LabVIEW", *2013 IEEE International Conference in MOOC Innovation and Technology in Education (MITE)*, 20-22 Dec. 2013, pp. 405-410.

[9] Kalani Nilesh, Anant Dipti, et al., "Performance Analysis of Linear Modulation Techniques with Different Channel Coding in LabVIEW", *IEEE International conference on Circuits, Controls and Communications (CCUBE), CCUBE*, 27-28 Dec. 2013, pp 1-5.

[10] Mathew Binu, George Pooppy, et.al, "BER Comparison of DCT and FFT Based OFDM Systems in AWGN and RAYLEIGH Fading Channels With Different Modulation Schemes", *Emerging Research Area and IEEE International Conference on Microelectronics, Communication and Renewable Energy (AICERA-2013 ICMiCR)*, June 4-6, 2013, pp. 1-4.

[11] Naznin Romana, Kumar Arun, "Simulation of Different Modulation Technique in CDMA System Using AWGN Channel" *International Journal of Computer & Technology*, Volume 11, Number 3, Oct. 15, 2013, pp.2346-2354.

[12] Shujiao Ji., Ming Zhu, "The Simulation Design of Communication System Based on LabVIEW", *IEEE 2nd International Conference on Measurement, Information and Control*, 16-18 Aug. 2013, pp. 661-664.

[13] Martinek Radek, Zidek Jan, "The Implementation of Channel Coding into the Digital Transmission Chain consisting of VSG PXI-5670 - VSA PXI-5661", *Przegląd Elektrotechniczny*, ISSN 0033-2097, R. 89 NR 7/2013, pp. 64-68.

[14] Kamala P.Ratna, Satyanarayana R.V.S., "Performance Analysis of Forward Error Correction Codes used for Transmission of data considering Failures in Coder/Decoder Circuits", *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering*, Volume 2, Issue 6, ISSN (Print): 2320 – 3765, ISSN (Online): 2278 – 8875, June 2013.

[15] Kaur Harjot & Verma Amit, "BER Performance Analysis of M-Ary DPSK Techniques Using Simulation Modelling", *International Journal of Electrical and Electronics Engineering Research (IJEEER)*, ISSN 2250-155X Volume 3, Issue 2, Jun 2013, pp. 93-100.

[16] Koshti Rahul, Jangalwa Madhvi, "Performance Comparison of WRAN over AWGN & RICIAN Channel Using BPSK & QPSK Modulation with Convolution Coding", *2013 International Conference on Communication Systems and Network Technologies (CSNT),IEEE Computer Society*, April 6-8, 2013, pp. 124-126.

[17] Swamy M. Katta, Deepthi M., et.al, "Performance Analysis of DSSS and FHSS Techniques over AWGN Channel", *International Journal of Advancements in Technology*, Volume 4, No. 1, March 2013.

[18] Awon Nuzhat Tasneem, Rahman Md. Mizanur, et.al., "Effect of AWGN & Fading (Raleigh & Rician) channels on BER performance of a WiMAX communication System", *International Journal of Computer Science and Information Security*, Vol. 10, No. 8, August 2012, p.11-17.

[19] Ahn Seok-Ki, Yang Kyeongcheol, "Evaluation of the Low Error-Rate Performance of LDPC Codes over Rayleigh Fading Channels Using Importance Sampling", *IEEE Transactions On Communications*, Volume 61, Number 6, June 2013.

[20] Youssef Tamer, Abdelfattah Eman, "Performance Evaluation of Different QAM Techniques Using Matlab/Simulink", *2013 IEEE Long Island Systems, Applications and Technology Conference (LISAT)*, 2013, pp. 1-5.

[21] Gohokar V.V., *IETE Journal of Education*, Volume 53, Issue 1, January-June 2012, pp.5-8.

[22] Islam Mohammed Safiqul, Khandaker Mayeen Uddin "Performance Comparison of Rate ½ Convolutional Codes with BPSK on Rayleigh and AWGN channels for Memory or Memory less Condition", *IJCIT*, ISSN: 2078-5828 (PRINT), ISSN 2218-5224 (ONLINE), Volume 02, Issue 02, 2012.

[23] Chen Ting, "Analysis of Forward Error Correcting Codes", *IEEE International Conference on System Science, Engineering Design and Manufacturing Informatization*, Volume 1, pp. 329-332, Oct. 22-23, 2011.

ACCEPTANCE SINGLE SAMPLING PLAN USING VAGUE PARAMETERS

S. Srikrishna

Department of Mathematics, SSN College of Engineering, Chennai, (India)

ABSTRACT

The purpose of this paper is to present the acceptance single sampling plan when the fraction of nonconforming items is a vague number. We have shown that the operating characteristic (oc) curves of the plan whose vague values depends on the ambiguity proportion parameter in the lot when that sample size and acceptance numbers is fixed having a higher and lower bounds. Finally we have concluded the discussion by a numerical example, whose values are represented by a vague triangular set.

Keywords: Statistical Quality Control, Acceptance Single Sampling, Vague Number.

I INTRODUCTION

In the classical set theory introduced by Cantor, German mathematician values of elements in a set are only one of 0 and 1. That is, for any element there are only two possibilities in or not in the set. The theory cannot handle the data with ambiguity and uncertainty.

Zadeh proposed fuzzy theory in 1965. The most important feature is that fuzzy set A is a class of objects that satisfy a certain property each object x has a membership degree of A, denoted by $\mu_A(x)$. This membership function has the following characteristics: The single degree contains the evidence for both supporting and opposing x. It cannot only represent one of the two evidences but it cannot represent both at the same time too.

In order to deal with this problem, Gau and Buehrer proposed the concept of vague set in 1993 by replacing the values of an element in a set with a subinterval of [0, 1]. Namely a true membership function t_v(x) and false membership function f_v(x) are used to describe the boundaries of membership degree. These two boundaries form a subinterval (t_v(x), 1-f_v(x)) of [0, 1]. The vague set theory improves description of the object in real world, becoming a promising tool to deal with inexact, uncertain or vague knowledge. Many researchers have applied this theory to many situation such as fuzzy control decision making, knowledge discovery. And the tool has presented more challenging than with the fuzzy set theory in applications.

Statistical quality control is an efficient method of improving a firm and process quality of production. Sampling for acceptance or rejection of a lot is an important field in statistical quality control.

Acceptance single sampling is one of the sampling methods for acceptance or rejection which is long with classical attribute quality characteristic. In sampling plans, the fraction of defined items is considered as a crisp value but in practice, the fraction of defined items value must be known exactly. Many times these values are estimated or it is provided by experiment. The vagueness present in the value of p with personal judgement experiment or estimated may be treated by means of vague set theory. As known vague set theory is a powerful

mathematical tool for modelling uncertainty with the evidence of both supporting and opposing, we define the imprecise proportion parameter as a vague number. With this definition, the number of non conforming items in the sample following a poisson distribution will have the vague parameter.

Classical acceptance sampling plans have been studied by many researchers. They are thoroughly selaborated by Schilling (1982). Single sampling by attributes with relaxed requirements were discussed by Ohta and Ichihashi (1988),and Grzegorzewski(1998,2001b). Grzegrozewski (2000b,2002) also considered sampling plan by variables with fuzzy requirements. Sampling plan by attributes for vague data were considered by Hrniewicz (1992).

The paper is organized as follows: section 2 gives the basic concepts of vague set theory and the arithmetic operations of triangular vague set. In section 3, we discuss about acceptance sampling plan with vague parameter. Section 4 deals with OC bands with vague parameter. Section 5 illustrates the above discussions with numerical examples and the conclusion is discussed in section 6.

II PRELIMINARIES AND DEFINITIONS

1.1 Basic Concepts of Vague Set.

Let U be the universe of discourse U $\{u_1, u_2, ..., u_n\}$. A vague set $\hat{A}$ [Chen and Shiy-Ming (2003), Lu.A and Nu.W (2004,2005)] in U is characterized by a truth membership function $t_{\hat{A}}$ $t_{\hat{A}}$: U→ $[0,1]$ and a false membership function $f_{\hat{A}}$ $f_{\hat{A}}$: U→ $[0,1]$, where $t_{\hat{A}}(u_i)$ is a lower bound of the grade of membership of u_i derived from the evidence for u_i. $f_{\hat{A}}(u_i)$ is a lower bound on the negation of grade of membership of u_i derived from the evidence against u_i such that $t_{\hat{A}}(u_i) + f_{\hat{A}}(u_i) \leq 1$. The grade of membership of u_i in the vague set $\hat{A}$ is bounded by a subinterval $[t_{\hat{A}}(u_i), 1 - f_{\hat{A}}(u_i)]$. For example, a vague set $\hat{A}$ in the universe of discourse U is shown in the figure 1:

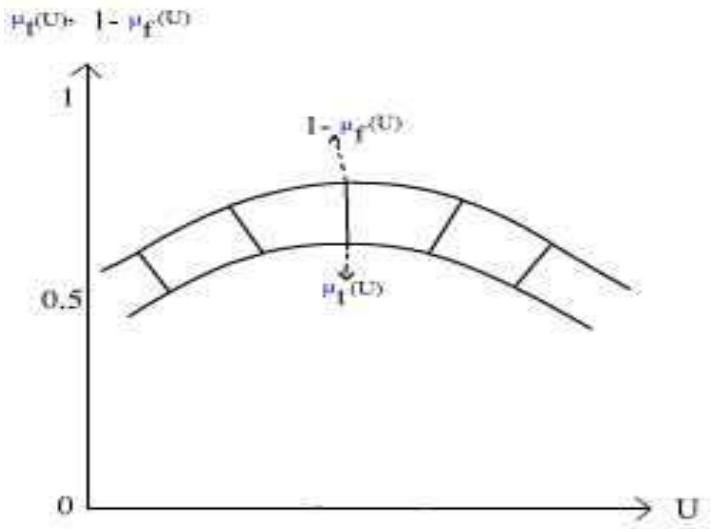

Fig 1: Vague Set

Definition 2.2.

Let $\hat{A}$ be a vague set of the universe of discourse U with truth membership function $t_{\hat{A}}$ and the false membership function $f_{\hat{A}}$ respectively. The vague set $\hat{A}$ is convex [Chen and Shiy-Ming (2003), Lu.A and Nu.W (2004,2005)], if and only if for every u_i in U,

$$t_{\hat{A}}(\lambda u_1 + (1-\lambda)u_2) \geq min\left(t_{\hat{A}}(u_1), t_{\hat{A}}(u_2)\right)$$

$$1 - f_{\hat{A}}(\lambda u_1 + (1-\lambda)u_2) \geq min\left(1 - f_{\hat{A}}(u_1), 1 - f_{\hat{A}}(u_2)\right),$$ where $\lambda \in [0, 1]$.

Definition 2.3.

A vague set $\hat{A}$ of universe of discourse U is called a normal vague set [Chen and Shiy-Ming (2003), Lu.A and Nu.W (2004,2005)], if $u_i \in U$, $1 - f_{\hat{A}(U)} = 1$. That is $f_{\hat{A}}(u_i)=0$.

Definition 2.4.

A vague number [Chen and Shiy-Ming (2003), Lu.A and Nu.W (2004,2005)] is a vague subset in the universe of discourse U that is both convex and normal.

In the following, we present the arithmetic operation of triangular vague set.

2.5 Arithmetic Operation of Triangular Vague sets.

Let us consider the triangular vague set $\hat{A}$, where the triangular vague set $\hat{A}$ can be parameterized by a tuple $\langle[(a,b,c);\mu_1],[(a,b,c);\mu_2]\rangle$, where μ_1 is the truth membership for (a,b,c) and μ_2 is the negation of false membership for (a,b,c). For convenience, the tuple can also be abbreviated into $\langle[(a,b,c);\mu_1,\mu_2]\rangle$, where $0 \leq \mu 1 \leq \mu 2 \leq \mu 3 \leq \mu 4 \leq 1$ are as follows:

$$\hat{A} \oplus \hat{B} = \langle[(a_1,b_1,c_1);\mu_1,\mu_2]\rangle \oplus \langle[(a_2,b_2,c_2);\mu_3,\mu_4]\rangle$$
$$= \langle[(a_1+a_2, b_1+b_2, c_1+c_2); min(\mu_1,\mu_3); min(\mu_2,\mu_4)]\rangle$$

$$\hat{A} \otimes \hat{B} = \langle[(a_1,b_1,c_1);\mu_1,\mu_2]\rangle \otimes \langle[(a_2,b_2,c_2);\mu_3,\mu_4]\rangle$$
$$= \langle[(a_1 \times a_2, b_1 \times b_2, c_1 \times c_2); min(\mu_1,\mu_3); min(\mu_2,\mu_4)]\rangle$$

Based on the above two operations, we now define the multiplication of two vague matrices. Let $\hat{P}$ and $\hat{Q}$ be the two matrices whose entries are triangular vague sets represented as $\hat{p}_{ij} = \langle[(p_{ij}^1, p_{ij}^2, p_{ij}^3); \mu_{ij}^1; \mu_{ij}^2]\rangle$, where μ_{ij}^1 is the truth membership of $(p_{ij}^1, p_{ij}^2, p_{ij}^3)$, μ_{ij}^2 is the negation of false membership of $(p_{ij}^1, p_{ij}^2, p_{ij}^3)$ and $\hat{q}_{ij} = \langle[(q_{ij}^1, q_{ij}^2, q_{ij}^3); \mu_{ij}^3; \mu_{ij}^4]\rangle$, where μ_{ij}^3 is the truth membership of $(q_{ij}^1, q_{ij}^2, q_{ij}^3)$ and μ_{ij}^2 is the negation of false membership of $(q_{ij}^1, q_{ij}^2, q_{ij}^3)$ respectively given by

$$\hat{P} = (\hat{p}_{ij}) = \begin{pmatrix} \hat{p}_{11} & \hat{p}_{12} & \cdots & \hat{p}_{1n} \\ \hat{p}_{21} & \hat{p}_{22} & \cdots & \hat{p}_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ \hat{p}_{n1} & \hat{p}_{n2} & \cdots & \hat{p}_{nn} \end{pmatrix} \qquad \hat{Q} = (\hat{q}_{ij}) = \begin{pmatrix} \hat{q}_{11} & \hat{q}_{12} & \cdots & \hat{q}_{1n} \\ \hat{q}_{21} & \hat{q}_{22} & \cdots & \hat{q}_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ \hat{q}_{n1} & \hat{q}_{n2} & \cdots & \hat{q}_{nn} \end{pmatrix}.$$

Then the multiplication of $\hat{P}$ and $\hat{Q}$ is defined by $\hat{P} \otimes \hat{Q} = \bigoplus_k (\hat{p}_{ik} \otimes \hat{q}_{kj})$

Definition 2.6.

Let x be a random variable having the poisson mass function P(x) stands for the probability that $x \in X$, then P(x)=$p(x) = \frac{e^{-\lambda}\lambda^x}{x!}$, x=0, 1, 2, ... and the parameter λ>0. Now if $\tilde{\lambda} > 0$ for λ is a fuzzy number, then $\tilde{p}$(x) to be fuzzy probability that X=x, we can find α-cut of this fuzzy number as $\tilde{p}(x) = \left\{\frac{e^{-\lambda}\lambda^x}{x!} / \lambda \epsilon \lambda[\alpha]\right.$ for every α∈[0, 1].

Let X be a random variable having the fuzzy probability distribution and $\tilde{p}$ in the definition (1) be small, which means that all p∈$\tilde{p}$[α] are sufficiently small, then $\tilde{p}$[a, b][α] is given by

$$\tilde{p}[a, b][\alpha] = \left\{\sum_{x=a}^{b} \frac{e^{-\lambda}\lambda^x}{x!} / \lambda \in n\tilde{p}[\alpha]\right\}$$

III ACCEPTANCE SAMPLING PLAN WITH VAGUE PARAMETER

Suppose that we want to inspect a lot with a large size of N. First take a randomized sample of size 'n' from the lot, then inspect all items in the sample and the number of defective items (d) will be count down. If the number of observed defective items is lesser than equal to acceptance number then the lot will be accepted, otherwise the lot rejection. If the size of lot be large the random variable d had a binomial distribution with parameter n and p in which p indicates the lot s defective items. However there exists the size of sample be large and p is small then random variable'd' has a Poisson distribution with λ=np. So, the probability for the number of defective items to be exactly equal to d is

$$p(d) = \frac{e^{-np}(np)^d}{d!}$$

and the probability of acceptance of the lot (p_a) is

$$p_a = p(d \leq e) = \sum_{d=0}^{c} \frac{e^{-np}(np)^d}{d!}.$$

Suppose we want to inspect a lot with the large size of N, such that the proportion of damaged item is not known precisely, so we represent this parameter with a vague number $\hat{p}$ with the evidence of both favourable and non favourable as follows: $\hat{p} = \{(p_1, p_2, p_3), \mu_t, 1 - \mu_f\}$.

A single sampling plan with a vague parameter if defined by the sample size n and acceptance number c and if the number of observation defective product is less than or equal to c, the lot will be acceptance. If N is a large number, then the number of defective items in this sample (d) has a binomial distribution with a vague value and if $\hat{P}$ is a small, then random variable (d) has a vague value whose parameter $\hat{\lambda}$=n$\hat{P}$ and so the vague probability for number of defective items in a sample size that is exactly equal to d is defined by means of α-cut given by

$\hat{P}$(d-defective)=$\left\{\hat{P}(\alpha), \mu_{t_{\hat{p}(\alpha)}}, 1 - \mu_{f_{\hat{p}(\alpha)}}\right\}$, where $\hat{P}(\alpha) = [P^1[\alpha], P^2[\alpha]]$ and $P^1[\alpha] = min\left\{\frac{e^{-\lambda}\lambda^d}{d!} | \lambda \epsilon n\hat{P}(\alpha)\right\}$

$$P^2[\alpha] = max\left\{\frac{e^{-\lambda}\lambda^d}{d!} | \lambda \epsilon n\hat{P}(\alpha)\right\}$$

and the vague acceptance probability is given by

$$\hat{P} = \left\{\hat{P}_a, \mu_{t_{p_a}}, 1 - \mu_{f_{p_a}}\right\}$$

Where $\tilde{P}_a$ is a triangular number $\tilde{P}_a = (P_a^1, P_a^2, P_a^3)$ defined by $\tilde{P}_a = \left\{\sum_{d=0}^{c} \frac{e^{-\lambda}\lambda^d}{d!} | \lambda \epsilon \tilde{\lambda}[\alpha]\right\}$.

This triangular number $\tilde{P}_a$ can be determined by means of α-cut,

$\tilde{P}_a(\alpha) = [P^1{}_a(\alpha), P^2{}_a(\alpha)]$ and

$$P_a^1(\alpha) = min\left\{\sum_{d=0}^{c} \frac{e^{-\lambda}\lambda^d}{d!} | \lambda \epsilon \tilde{\lambda}(\alpha)\right\}$$

$$P_a^2(\alpha) = max\left\{\sum_{d=0}^{c} \frac{e^{-\lambda}\lambda^d}{d!} | \lambda \epsilon \tilde{\lambda}(\alpha)\right\}$$

IV OC-BAND WITH VAGUE PARAMETER

Operating characteristic curve is one of the important criteria in the sampling plan. By this curve one could be determined the probability of acceptance or rejection of a lot having some specific defective items. The OC curve represents the performance of the acceptance sampling plans by plotting the probability of acceptance a lot versus its production quality which is expressed by the proportion of non conforming items in the lot [B.P.M. Duate, P.M. Saraiva (2008)]. OC curve aids in selection of plans that are effective in reducing risk and indicates discriminating power of the plan.

Suppose that the event A is the event of acceptance of a lot. Then the vague probability of acceptance a lot in terms of fraction of defective items having vague values represented as a triangular vague value. The uncertainty degree of a proportion parameter is one of the factors that bandwidth depends on that. Knowing the uncertainty degree of proportion parameter with the evidence of acceptance membership value and non acceptance membership value and the variation of its position as horizontal axis we have different vague number $\hat{P} = \left(\tilde{P}, \mu_{t_p}, 1 - \mu_{f_p}\right)$ and hence we will have different proportion (P) which the OC bands are plotted in terms of it. To achieve this aim, we consider the structure of $\hat{P}$ as follows:

$\hat{P} = \left(\tilde{P}, \mu_{t_p}, 1 - \mu_{f_p}\right)$, where $\tilde{P} = (k, a_2 + k, a_3 + k)$ which can be obtained by using α-cuts.

Let $\hat{\lambda}$=$\left(\tilde{\lambda}, \mu_{t_p}, 1 - \mu_{f_p}\right)$. Then $\hat{\lambda} = n\hat{P} = \left((nk_1, na_2 + nk, na_3 + nk), \mu_{t_\lambda}, 1 - \mu_{f_\lambda}\right)$ with which variation k in the domain of the interval between 0 and 1- a_3. The OC band is plotted according to the following calculation:

The triangular number $\tilde{P}$ can be obtained by using α-cut as follows:

$$\tilde{P}[\alpha] = [P_1(\alpha), P_2(\alpha)]$$

$$= [k + a_2\alpha, a_3 + k - (a_3 - a_2)\alpha]$$

and $\tilde{\lambda}$ are obtained as $\tilde{\lambda}[\alpha] = [\lambda_1(\alpha), \lambda_2(\alpha)]$

$= [nk + na_2\alpha, na_3 + nk - n(a_3 - a_2)\alpha]$ using α-cuts,

$\therefore \hat{P}_a = \left(\tilde{P}_a, \mu_{t_{p_a}}, 1 - \mu_{f_{p_a}}\right)$, where $\hat{P}_a = \left[P_{a_1}[\alpha], P_{a_2}[\alpha]\right]$

$$= \left[min\left\{\sum_A \frac{e^{-\lambda}\lambda^d}{d!} | \lambda \epsilon \tilde{\lambda}[\alpha]\right\}, max\left\{\sum_A \frac{e^{-\lambda}\lambda^d}{d!} | \lambda \epsilon \tilde{\lambda}[\alpha]\right\}\right]$$

V EXAMPLE

Example 5.1.

Let us assume that experience of a management company shows that half percent are ill-packed. Major customers choose and inspect 60 items of this product available in a large store to buy them. If the number of non conforming items in this sample equals zero or one, the customers will buy all products in the store. If the non confirming increases, the customer will not buy them. Because of the proportion of defective products has explained linguistically we can consider that as a vague number $\hat{P} = ((0,0.005,0.01), 0.9,0.85)$.

Therefore the probability of purchasing will be described in the following:

If n=60, c=1, then $\hat{P} = ((0,0.005,0.01), 0.9,0.85)$

$\hat{\lambda} = ((0,0.3,0.6), 0.85,0.8)$ = ([0.3α,0.6-0.3α],0.85,0.8) and

$\hat{P}_a = ([(1.6 - 0.3\alpha)e^{-(0.6-0.3\alpha)}, (1 + 0.3\alpha)e^{-0.3\alpha}], 0.85,0.8)$.

Using 0-cut and 1-cut, we get $\hat{P}_a = ((0.8781, 0.9391,1), 0.9,0.8)$ means that having more evidence of acceptance memberships, it is expected that for every 100 lots in such a process 88 to 100 lots will be accepted.

In this example, if we take c = 1 for a_2 = 0.005, a_3 = 0.01, then we have at 0 – cut

$\hat{\lambda} = ([nk, nk + 0.01n]; 0.85; 0.8), 0 < k < 0.99$ and

$\hat{P}_a = ([(1 + nk + 0.01n)e^{-(nk+0.01n)}, (1 + nk)e^{-nk}]; 0.9; 0.8)$

Table 5.1: Vague Probability of Acceptance

k	$\hat{P}$	$\hat{P}_a$
0	<(0,0.05,0.1);0.9;0.85>	<(0.8781,0.939,1);0.9;0.8>
0.01	<(0.01,0.015,0.02);0.9;0.85>	<(0.6626,0.7735,0.8781);0.9;0.85>
0.02	<(0.02,0.025,0.03);0.9;0.85>	<(0.4628,0.5627,0.66260;0.9;0.8>
0.03	<(0.03,0.035,0.04);0.9;0.85>	<(0.3084,0.3856,0.4628);0.9;0.8>
0.04	<(0.04,0.045,0.05);0.9;0.85>	<(0.1991,0.2575,0.4628);0.9;0.8>
0.05	<(0.05,0.055,0.06);0.9;0.85>	<(0.1257,0.16240.1991);0.9;0.8>

Fig 2 shows the OC band of the example. This figure represents that then the OC band having high evidence of grade of membership and negation of grade of membership against the evidence, when the process quality decrease from a very good state to a moderate state.

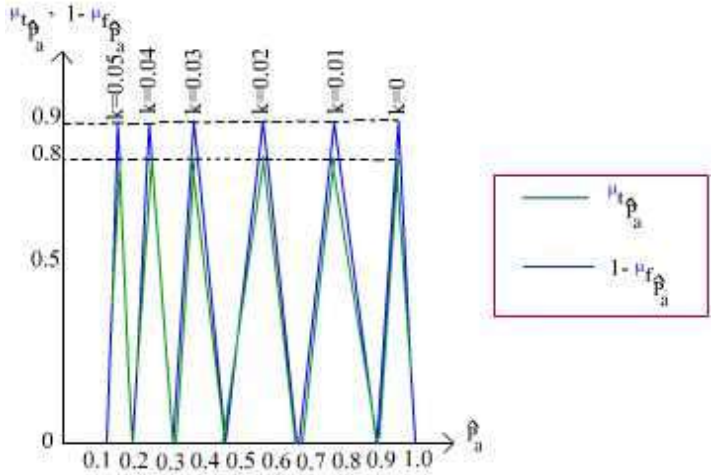

Fig 2: OC Band for a single Sampling Plan with Vague Parameter

Example 5.2: Suppose that c = 0, n = 20 in example 5. 1, then we have $a_2 = 0.005$, $a_3 = 0.01$

$\hat{P} = \langle (k, k+0.005, k+0.01); 0.8; 0.9 \rangle$ and $\hat{\lambda} = \langle (20k, 20k+0.1, 20k+0.2); 0.85; 0.95 \rangle$, for $0 \le k \le 0.99$.

Therefore OC curve in terms of vague probabilities is as

follows: $\hat{P}_{ab} = \langle (e^{-(0.2+20k)}, (0.5)(e^{-(0.2+20k)} + e^{-(20k)}), e^{-20k}); 0.85; 0.9 \rangle$

Table 5.2: Vague Probability of Acceptance

k	$\hat{P}_{ab}$
0	<(0.8787,0.9094,1);0.85;0.9>
0.01	<(0.6703,0.7445,0.8787);0.85;0.9>
0.02	<(0.5488,0.6095,0.6703;0.85;0.9>
0.03	<(0.4493,0.4991,0.5488);0.85;0.9>

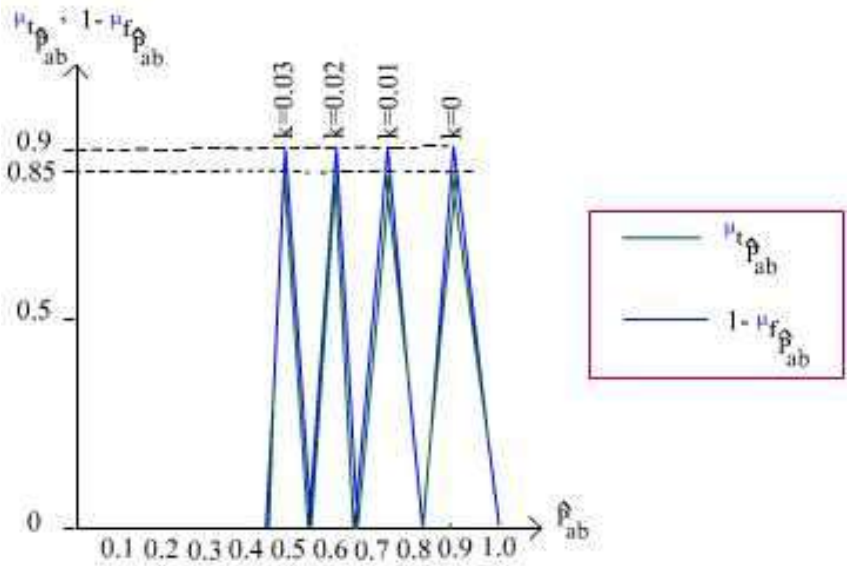

Fig 3: OC Band for a single Sampling Plan with Vague Parameter

The above figure shows OC band for n = 20 indicating that 0.85 is the lower bound for the membership of evidence for the OC bands and 0.9 is the upper bound for the negation of membership against the evidence for the vague probability of acceptance for proportion of defective items whose flow follows reduction of values and it will be more the increase of n.

VI CONCLUSION

In this paper, we have proposed a method for designing acceptance single sampling plan with vague quality characteristic using Poisson distribution represented as triangular vague probabilities. As it was shown that OC curves of the plan is like a band having a higher and lower bounds, we had shown that we made an attempt to capture the vagueness of the plan of OC bands.

REFERENCES

[1] E.G. Schiling, *Acceptance Sampling Quality Control* Dekker, New York 1982.

[2] H. Ohta ,H. Ichihashi Determination of single-sampling attribute plans based on membership function, *Int. J. Prod, Res 26*, 1477-1485,1998,.

[3] P. Grzegorzewski A soft design of acceptance sampling by attributes, in: *proceedings of the VIth international workshop on intelligent statistical quality control Wurzburg,* September 14-16 , PP.29-38, 1988.

[4] P. Grzegorzewski Acceptance sampling plans by attributes with fuzzy risks and quality levels, in: *Frontiers in frontiers in statistical quality control. Vol. 6, Eds*. Wilrich P. Th. Lenz H. J. Springer, Heidelberg, PP. 36-46, 2001 b.

[5] P. Grzegorzewski A soft design of acceptance sampling plans by variables, in: *technologies for contrueting intelligent systems,* Eds, speringer, vol. 2. pp. 275-286, 2002.

[6] O. Hryniewisz, statistical acceptance sampling with uncertain information from a sample and fuzzy quality criteria working paper of SRI PAS, Warsow, (in polish), 1992.

[7] Chen., and Shyi-Ming., "Analysing Fuzzy System Reliability using Vague Set Theory", International Journal of Applied Science and Engineering, Vol 1:No.1, 82 – 88, 2003.

[8] Lu.A and Ng.W., " Managing Merged Data by Vague Functional Dependencies", Proceeding of Conceptual Modeling ER – 2004, 259 – 272, 2004.

[9] Lu. A and Ng.W., " Vague Sets or Intuitionistic Fuzzy Sets for Handling Vague Data which one is better", Proceeding of Conceptual Modeling ER – 2005, 401 – 416, 2005.

[10] B.P.M. Duate, P.M. Saraiva, "An optimization basd approach for designing attribute acceptance sampling plans, " *Int. journal of quality & reliability management.vol. 25 no. 8,* 2008.

FLYING WIND MILL

S.Ramya[1], A.Tejaswini[2], I.Sneha[3]

[1,2,3]CVR College Of Engineering, (An Autonomous Institution), Vastunagar, Mangalpalli (V),Ibrahimpatnam (M), Rangareddy (D),Telangana (India)

ABSTRACT

The present day conventional windmills have many drawbacks. My paper suggests an alternative to overcome the drawbacks. These alternatives are FLYING WINDMILLS .The wind is much steadier at altitudes, so you get even more advantage over conventional windmills in this NEW GENERATION WINDMILLS.

Flying windmills have advantages over their land-based counterparts which is because of factors such as contours of the land and daily heating and cooling patterns, often face either inadequate wind or turbulent winds, necessitating expensive designs. No such impediments occur in the jet stream, where air moves near-constantly and at several times the speed that it does at 100 feet off the ground, allowing much more energy to be captured from each square meter of wind

Flying windmills are even more advantageous as it has ad-hoc generation: devices with a reasonably simple tether-system do not have to be permanently installed in one place, They could be trucked out to any location that needed them.

Keywords: MARS, Flying Windmills.

I INTRODUCTION

Wind results from air in motion. The circulation of air in the atmosphere is caused by the non-uniform heating of the earth's surface by the sun. Despite the wind's intermittent nature, wind patterns at any particular site remain remarkably constant year by year. Average wind speeds are greater in hilly and coastal areas than they are well inland. The winds also tend to blow more consistently and with greater strength over the surface of the water where there is a less surface drag.

Fig .1. Conventional Wind Turbines

Wind speeds increases with height. They have traditionally been measured at a standard height of ten meters where they are found to be 20-25% greater than close to the surface. At a height of 60m they may be 30-60% higher because of the reduction in the drag effect of the earth's surface.

Conventional wind energy collectors are horizontal axis machines eg. Dutch type wind mill and vertical axis machines eg. Darrieus rotor.

In spite of their advantages, the conventional methods do suffer from several disadvantages. Some of them are as follows:

The turbines may create a lot of noise, which indirectly contributes to noise pollution.

1. Wind can never be predicted. Since wind energy will require knowledge of weather and wind conditions on long term basis, it may be impractical. Therefore, in areas where a large amount of wind energy is needed one cannot depend completely on wind
2. Many potential wind farms, places where wind energy can be produced on a large scale, are far away from places for which wind energy is best suited. Therefore, the economical nature of wind energy may take a beating in terms of new sub stations and transmission lines.
3. Wind turbines have a negative impact on birds, which can be killed or injured through collision with the rotating blades.
4. Wind turbines cause loss of habitat to wildlife due to the disturbance from its noise, movement of blades, subtle food chain changes and electromagnetic fields that in some animal species affects their sonar systems.
5. Wind turbines cause interference to nearby televisions (TV's within a couple of kilometers of the wind turbine).

The most important disadvantage of conventional types is that there is not always (enough) wind. Whereas at higher altitudes, wind conditions are much better.

II WHAT ARE FLYING WIND MILLS?

Fig.2.Flying Windmill

It is a windmill similar to a conventional one in its working principle but here the rotor and generator will be **floating** in air just like a hot air balloon. The generator will be enclosed in an **inflatable structure** and this structure is held by a **Tether** and tied to the ground. Canadian engineer Fred Ferguson, specialized in airships,

proposed an innovative system called as Magenn Air Rotor System (MARS). Magenn's design is radically different from other windmills on the market it would not use propeller blades. Instead, it would be a helium blimp, with Savories-style scoops causing it to rotate around motors at the attachment-points to its tether.

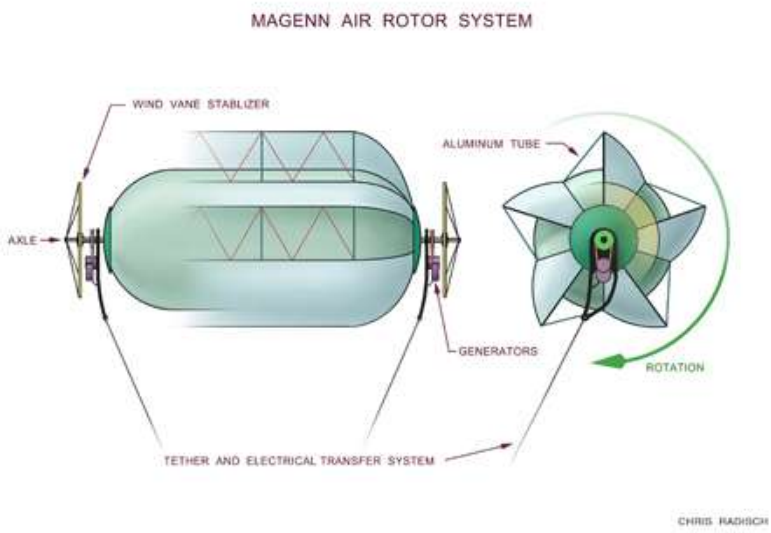

Fig.3.Magenn Air Rotor System

The helium filled MARS is a buoyant turbine made of vectran – a bulletproof material that is stronger than steel of the same thickness – and is connected to the ground by an insulated conductive tether. The unit can rise to a height of 300 to 1,000 feet to take advantage of more constant and higher wind speeds at higher altitudes that conventional wind turbines are unable to reach. While in the sky, the MARS turbine spins in the wind, generating electricity. The current is transferred down the tether for consumption, battery storage or transmitted to a power grid.

The MARS units will have an internal bladder system to maintain pressure. Helium leakage is not an issue under normal conditions; excess air turbulence and gusting might present a small risk but this craft has been designed to withstand challenges. Unlike in a child's balloon, helium leaks at a rate of only half of a percent per month in these designs.

Helium is a light inert gas and the second most abundant element in the universe. Helium provides extra lift and will keep MARS at altitude in very low winds or calm air. It is also plentiful, inexpensive and environmentally safe. Helium's inert quality over other lifting gases makes it very acceptable.

MARS will be constructed with composite fabrics used in airships today. The fabric will be either woven Dacron or Vectran with an inner laminated coating of Mylar to reduce porosity and an exterior coating of Tedlar which will provide ultra-violet protection, scuff resistance and color.

Over speed controls are built into the design of MARS. On the larger MARS units, excessive speed is controlled by moderating tether height. Pressure is constantly monitored and controlled. Rotation speed, wind speed, and generator functions are also monitored. Depending on size, either DC or AC generators will be used, with rectification as necessary.

MARS units must and will have lighting every 50 feet, and the lights must flash once per second. All MARS units must and will have a mechanism to quickly deflate in case a unit gets detached from its tether.

III LIFTING MECHANISM

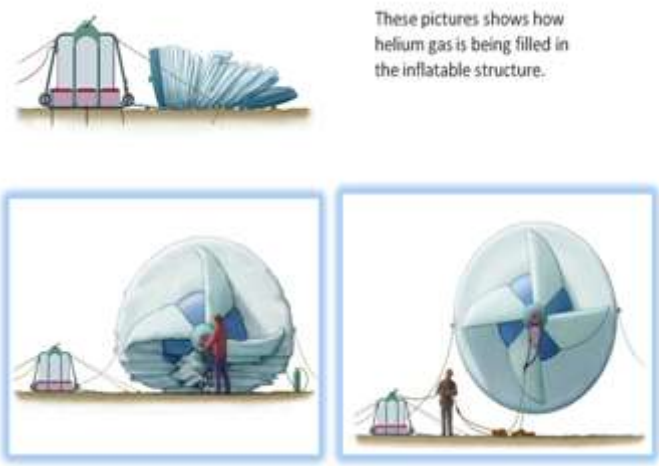

Fig.4.Helium Gas Filled In The Inflatable structure

The **Magenn Air Rotor System (MARS)** is the next generation of wind turbines with cost and performance advantages over existing systems. MARS is a lighter-than-air tethered wind turbine that rotates about a horizontal axis in response to wind, generating electrical energy. Helium sustains the Magenn Air Rotor System, which ascends to an altitude as selected by the operator for the best winds. Its rotation also generates the **"Magnus"** effect. This aerodynamic phenomenon provides additional lift, keeps the MARS device stabilized, positions MARS within a very controlled and restricted location, and finally, causes MARS to pull up overhead to maximize altitude rather than drift downwind on its tether.

MARS is filled with helium gas, which is inert and non-flammable. The lifting gas creates a lift force that is in excess of the total weight of the system. The helium provides at least twice the positive lift versus the overall weight of the MARS unit. Additional lift is also created when the rotor is spinning in a wind. The aerodynamic effect that produces additional lift is called the Magnus Effect

The combined lifting effect from buoyant (helium) lift and aerodynamic (Magnus) lift help stabilize the Air Rotor against "leaning" in the wind. In tests, an Air Rotor went straight up and held a near vertical position in various wind speeds, since the Magnus effect increases as the wind speed increases. Research indicates that maximum lean will never be more than 45 degrees from the vertical.

Fig.5.Arrangement of Mars

Helium is not the only thing that keeps the object aloft. Combined with its shape, the spinning generates lift using what is called the Magnus effect, which also tends to keep the craft overhead on its tether, rather than drifting downwind. The bigger the MARS unit, the easier it is to build heavier stronger structures, envelopes, and generators. As an example, the largest MARS units planned (100' x 300') will have tens of tons of buoyant (helium) lift. This is well in excess of the overall Air Rotor system weight.

IV HOW DOES IT WORK?

As the rotor of the windmill rotates due to high velocity wind it produces very high torque.. There is a step-up gear box which connects the low-speed shaft to the high-speed shaft and increases the rotational speeds from about 30 to 60 rotations per minute (rpm) to about 1200 to 1500 rpm. The electrical energy thus produced is transferred down the tether for consumption, or to a set of batteries or the power grid.

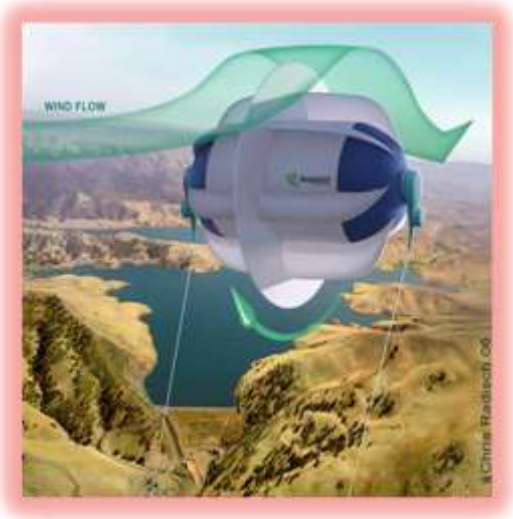

Fig.6.Floating of Mars

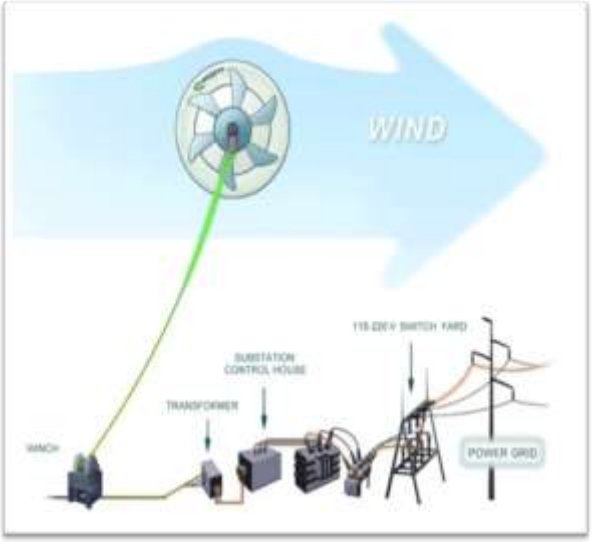

Fig.7.Working of Mars

Table.1.Specifications of 4kw Mars

Magenn Power Product	Model 4kW
Size (Diameter x Length)	4m*12m
Shipping Weight	Nearly 158kgs
Volume of Helium	170m3
Tether Height	200 ft standard - up to 800 ft optional tether length, in increments of 100 feet
Start-up Wind Speed	1 m/sec
Rated Wind Speed	12.5 m/sec

Rated Power	4000 Watts
Temperature Range	-40ºC to +60ºC
Generators	2 x 2 kW
Output Form	Various Options Available: 120 VAC 60Hz - 240 VAC 50 Hz - Regulated DC 12-120V
Warranty	5 Years
Life Cycle	15 Years
Price (USD) (Estimated)	$9,999

MARS 4kW (Estimated) Performance Specifications : MARS 4kW Performance

Estimated performance data is shown in the graph below.

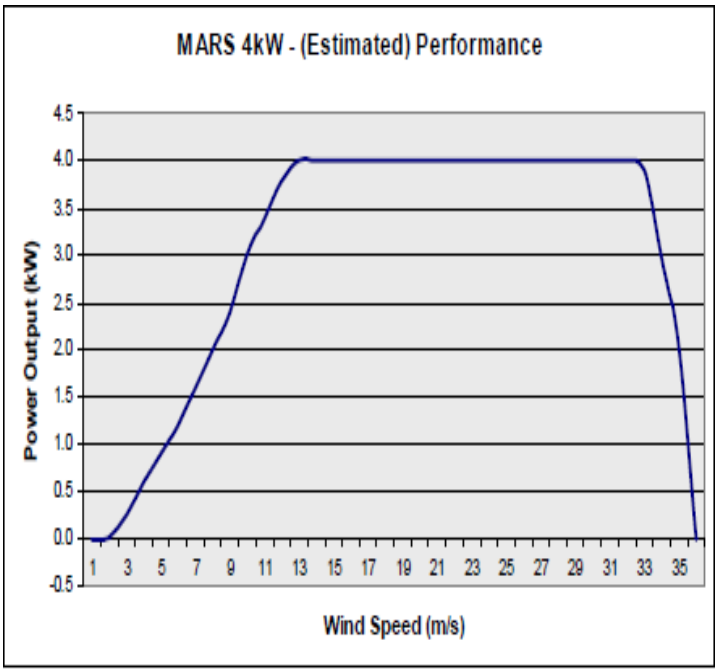

Fig.9.Performance Of Power Flow Mars

The Advantages of MARS

1. Low cost electricity – less than Rs. 5 per kWh.
2. Bird and bat friendly.
3. Lower noise
4. Wide range of wind speeds - 2 to more than 28 meters/second
5. Higher altitudes - from 200 to 800 feet above ground level are possible without expensive towers or cranes.
6. Fewer limits on placement location - coast line placement is not necessary.
7. Ability to install closer to the power grid.

8. Ideal for off grid applications or where power is not reliable.
9. They do not require land, wide roads and heavy machinery for assembly. MARS units remove these limitations because the units do not require cranes or special roads for installation.

Disadvantages

1. MARS units cannot be installed within five miles of the boundary of any airport.
2. Initial cost is high.
3. Another disadvantage of floating windmills is that they have to be taken down in extremely powerful winds, whereas common wind turbines are simply shut down.

Applications

1. Off grid for cottages and remote uses such as cell towers and exploration equipment.
2. Developing nations where infrastructure is limited or nonexistent.
3. Rapid deployment (to include airdrop) to disaster areas for power to emergency and medical equipment, water pumps, and relief efforts (ex. Katrina, Tsunami).
4. And military applications.

IV CONCLUSION

In case of flying windmills the MARS system is very simple to install, requiring minimal on-site work. Despite its large size, no cranes or oversized vehicles were required to deploy the system, nor are they expected to be required for larger units. High-altitude wind power using tethered wind turbine devices has the potential to open up a new wind resource in areas that are not served by conventional turbines.

REFERENCES

- http://www.theatlantic.com
- www.magenn.com
- http://www.nampet.com
- www.dnvgl.com
- www.William kamkwamba.com
- www.Herman Melville.com

VARIANCE OF TIME TO RECRUITMENT FOR A TWO GRADED MANPOWER SYSTEM WITH CORRELATED INTER-DECISION TIMES AND INDEPENDENT INTER-EXIT TIMES

G. Ishwarya[1], A. Srinivasan[2]

[1]*Assistant Professor in Mathematics, Agni College of Technology, OMR, Thalambur, Chennai, Tamil Nadu, (India)*

[2] *Professor Emeritus, PG & Research Department of Mathematics, Bishop Heber College, Tiruchirappalli, Tamil Nadu, (India)*

ABSTRACT

In this paper, the problem of time to recruitment for a two graded manpower system subject to attrition which takes place due to policy decisions is studied using a univariate policy of recruitment. Assuming that the policy decisions and exits occur at different epochs, the variance of time to recruitment is obtained using a univariate policy of recruitment when the inter-policy decision times are exchangeable and constantly correlated exponential random variables and inter- exit times form an ordinary renewal process. The analytical results are obtained by using Laplace transform technique in the analysis and the results are numerically illustrated. The effect of the nodal parameters on the performance measure is studied.

Keywords: Two Grade Manpower System; Decision and Exit Epochs; Correlated Inter-Decision Times; Univariate CUM Policy of Recruitment; Ordinary Renewal Process; Variance of Time to Recruitment AMS MSC 2010: 90B70, 91B70

I. INTRODUCTION

Exodus of personnel is a common phenomenon in any marketing organization whenever the organization announces revised policies regarding sale target, revision of wages, incentives and perquisites. This in turn produces loss in man-hours, which adversely affects the sales turnover of the organization. Frequent recruitment is not advisable as it will be expensive due to the cost of recruitment. As the loss of manhours is unpredictable, a suitable recruitment policy has to be designed to overcome this loss. One univariate recruitment policy which is often used in the literature is based on shock model approach for replacement of system in reliability theory. In this policy, known as univariate CUM policy of recruitment, the cumulative loss of manpower is permitted till it reaches a level, called the breakdown threshold and when this cumulative loss exceeds the threshold, recruitment is carried out. In [1, 2] the authors have discussed several manpower planning models using Markovian and renewal theoretic approach. In [3] this problem is studied for the first time using this policy. In [4] the authors have considered a two grade manpower system and obtained the mean time to recruitment

using CUM policy of recruitment when (i) the loss of manpower and the inter-decision times form separately a sequence of independent and identically distributed exponential random variables with different means (ii) the threshold for the cumulative loss of manpower in the organization is the maximum of the threshold for the cumulative loss of manpower in the two grades. In [5, 7] the authors have obtained the mean time to recruitment for a two grade manpower system having SCBZ thresholds. In [6] the author has obtained the mean and variance of time to recruitment for a two grade manpower system involving combined thresholds. In all the above cited work, it is assumed that attrition takes place instantaneously at decision epochs. This assumption is not realistic as the actual attrition will take place only at exit points which may or may not coincide with decisions points. This aspect is taken into account for the first time in [13] and the variance of the time to recruitment for a single grade manpower system is obtained when the inter-decision times and exit times are independent and identically distributed exponential random variables using a univariate policy for recruitment by Laplace transform technique. In [14], the authors have studied the research in [13] using a different probabilistic analysis. Again in [15, 16], the authors have obtained the mean time to recruitment for a single grade manpower system by considering different epochs for decisions and exits with correlated inter-decision times. In [17], the authors have extended the work in [14] for a two grade manpower system. The present paper extends the research work of [15] & [17] for a two grade manpower system by considering exchangeable and constantly correlated exponential inter-decision times using Laplace transforms techniques.

II. MODEL DESCRIPTION AND ANALYSIS

Consider an organization with two grades (grade-1and grade-2) taking policy decisions at random epochs in $(0,\infty)$ and at every decision making epoch a random number of persons quit the organization. There is an associated loss of manpower, if a person quits. It is assumed that the loss of manpower is linear and cumulative. For i=1,2,3…, let X_i be independent and identically distributed exponential random variables representing the amount of depletion of manpower (loss of man hours) in the organization due to ith exit point with probability distribution $M(.)$, density function $m(.)$, laplace transform $\overline{m}(.)$ and mean $\frac{1}{\lambda}$ (λ >0). Let S_i be the cumulative loss of manpower up to i-th decision. Let U_i, the time between (i-1)th and ith decisions, be exchangeable and constantly correlated exponential random variable with probability distribution function $F(.)$, density function $f(.)$ and mean u. Let R be the correlation between U_i and U_j, $i \neq j$ and $b = u(1-R)$, $A(s) = \frac{1}{1+bs}$. Let R_i be the time between (i-1)th and ith exits with distribution function $G(.)$ and density function $g(.)$. Let $F^*(.)$ and $G^*(.)$ be the Laplace Stieltjes transform of $F(.)$ and $G(.)$ respectively. Let Y_1, Y_2 be continuous random variables representing the thresholds for the cumulative loss of manhours in grade – 1 and grade – 2 respectively. Let Y be the breakdown threshold for the cumulative loss of manhours in the organization with distribution function $H(.)$ and density function $h(.)$. Let q (q≠0) be the probability that

every policy decision produces an attrition. Let T be a continuous random variable denoting the time for recruitment with mean $E(T)$ and variance $V(T)$.

The univariate CUM policy of recruitment employed in this paper is stated as follows: **Recruitment is done whenever the cumulative loss of man hours in the organization exceeds the breakdown threshold Y**.

The survival function of T is written as

$$P(T>t)=\sum_{k=0}^{\infty}$$ {Probability that exactly k-exit points in (0, t] $\times$ (probability that the total loss of manhours in these k-exit points does not cross the threshold Y)}

From renewal theory [12],

$$P(T>t)=\sum_{k=0}^{\infty}\left[G_k(t)-G_{k+1}(t)\right]P(S_k<Y) \qquad \text{.....(1)}$$

By the law of total probability [11],

$$P(S_k<Y)=\int_0^{\infty}P(S_k\le y)dP(Y\le y)$$

$$i.e, P(S_k<Y)=\int_0^{\infty}M_k(y)h(y)dy \qquad \text{.....(2)}$$

We now consider different forms for Y and obtain the variance of the time to recruitment by assuming specific distributions to Y_1 and Y_2.

Model – I: $Y=Max(Y_1,Y_2)$

Case(i): Y_1 **and** Y_2 **~exponential distribution with parameters** α_1 **and** α_2 **respectively.**

In this case

$$h(y)=\alpha_1 e^{-\alpha_1 y}+\alpha_2 e^{-\alpha_2 y}-(\alpha_1+\alpha_2)e^{-(\alpha_1+\alpha_2)y} \qquad \text{.....(3)}$$

Substituting (3) in (2) and on simplification, we get

$$P(S_k<Y)=A_1^k+A_2^k-A_3^k \qquad \text{.....(4)}$$

where $A_1=\overline{m}(\alpha_1)$, $A_2=\overline{m}(\alpha_2)$ and $A_3=\overline{m}(\alpha_1+\alpha_2)$ .....(5)

From (1) & (4),

$$P(T>t)=1+(A_1-1)\sum_{k=1}^{\infty}G_k(t)A_1^{k-1}+(A_2-1)\sum_{k=1}^{\infty}G_k(t)A_2^{k-1}-(A_3-1)\sum_{k=1}^{\infty}G_k(t)A_3^{k-1} \qquad \text{.....(6)}$$

Since $L(t)=1-P(T>t)$, from (6)

$$L(t)=(1-A_1)\sum_{k=1}^{\infty}G_k(t)A_1^{k-1}+(1-A_2)\sum_{k=1}^{\infty}G_k(t)A_2^{k-1}-(1-A_3)\sum_{k=1}^{\infty}G_k(t)A_3^{k-1} \qquad \text{.....(7)}$$

Taking Laplace Stieltjes Transform on both sides of (7) & using convolution theorem for Laplace transform,

$$L^*(s)=\frac{(1-A_1)G^*(s)}{\left[1-A_1G^*(s)\right]^2}+\frac{(1-A_2)G^*(s)}{\left[1-A_2G^*(s)\right]^2}-\frac{(1-A_3)G^*(s)}{\left[1-A_3G^*(s)\right]^2} \qquad \text{.....(8)}$$

It can be proved that, $G(x)$ satisfies the relation

$$G(x)=\sum_{n=1}^{\infty}q(1-q)^{n-1}F_n(x) \qquad \text{.....(9)}$$

and from [10], $F_k^*(s)=\dfrac{\left(m(s)\right)^k}{1+\left(\dfrac{kR(1-m(s))}{(1-R)}\right)}$ ...(10)

$$\left.\begin{aligned}&\text{Since } E(T)=-\left[\frac{d}{ds}L^*(s)\right]_{s=0}\\ &\text{and } E(T^2)=\left[\frac{d^2}{ds^2}L^*(s)\right]_{s=0}\end{aligned}\right\} \qquad \text{.....(11)}$$

from (8), (9) (10) & (11), we get

$$E(T)=\frac{b}{(1-R)q}\left[\frac{1}{(1-A_1)}+\frac{1}{(1-A_2)}-\frac{1}{(1-A_3)}\right] \qquad \text{.....(12)}$$

$$\begin{aligned}E(T^2)=&\frac{2b^2}{q^2(1-R)^2}\left[\frac{1}{(1-A_1)^2}+\frac{1}{(1-A_2)^2}-\frac{1}{(1-A_3)^2}\right]\\&+\frac{2b^2R^2(1-q)}{q^2(1-R)^2}\left[\frac{1}{(1-A_1)}+\frac{1}{(1-A_2)}-\frac{1}{(1-A_3)}\right]\end{aligned} \qquad \text{.....(13)}$$

V(T) can be calculated from

$$V(T)=E(T^2)-[E(T)]^2 \qquad \text{.....(14)}$$

(12) together with (13) & (14) give $V(T)$ for the present case.

Case (ii): Y_1 and Y_2 ~ extended exponential distribution [8] with shape parameter 2 and scale parameters α_1 and α_2 respectively.

In this case

$$\begin{aligned}h(y)=&2\alpha_1e^{-\alpha_1y}-2\alpha_1e^{-2\alpha_1y}+2\alpha_2e^{-\alpha_2y}-4(\alpha_1+\alpha_2)e^{-(\alpha_1+\alpha_2)y}+2(2\alpha_1+\alpha_2)e^{-(2\alpha_1+\alpha_2)y}\\&-2\alpha_2e^{-2\alpha_2y}+2(\alpha_1+2\alpha_2)e^{-(\alpha_1+2\alpha_2)y}-(2\alpha_1+2\alpha_2)e^{-(2\alpha_1+2\alpha_2)y}\end{aligned} \qquad \text{...(15)}$$

$$P(S_k<Y)=2A_1^k+2A_2^k-4A_3^k-A_4^k-A_5^k+2A_6^k+2A_7^k-A_8^k \qquad \text{.....(16)}$$

$$E(T)=\frac{b}{(1-R)q}\left[\begin{array}{l}\frac{2}{(1-A_1)}+\frac{2}{(1-A_2)}-\frac{4}{(1-A_3)}-\frac{1}{(1-A_4)}\\ -\frac{1}{(1-A_5)}+\frac{2}{(1-A_6)}+\frac{2}{(1-A_7)}-\frac{1}{(1-A_8)}\end{array}\right] \qquad \text{.....(17)}$$

and

$$E(T^2)=\frac{2b^2}{(1-R)^2q^2}\left[\begin{array}{l}\frac{2}{(1-A_1)^2}+\frac{2}{(1-A_2)^2}-\frac{4}{(1-A_3)^2}-\frac{1}{(1-A_4)^2}\\ -\frac{1}{(1-A_5)^2}+\frac{2}{(1-A_6)^2}+\frac{2}{(1-A_7)^2}-\frac{1}{(1-A_8)^2}\end{array}\right]$$
$$+\frac{2b^2R^2(1-q)}{(1-R)^2q^2}\left[\begin{array}{l}\frac{2}{(1-A_1)}+\frac{2}{(1-A_2)}-\frac{4}{(1-A_3)}-\frac{1}{(1-A_4)}\\ -\frac{1}{(1-A_5)}+\frac{2}{(1-A_6)}+\frac{2}{(1-A_7)}-\frac{1}{(1-A_8)}\end{array}\right] \qquad \text{.....(18)}$$

where A_1, A_2 & A_3 are given in (5) and

$$A_4=\overline{m}(2\alpha_1);\ A_5=\overline{m}(2\alpha_2);\ A_6=\overline{m}(2\alpha_1+\alpha_2);\ A_7=\overline{m}(\alpha_1+2\alpha_2);\ A_8=\overline{m}(2\alpha_1+2\alpha_2) \qquad \text{.....(19)}$$

(17) together with (18) & (14) give $V(T)$ for the present case.

Case (iii): Distribution of Y_1 and Y_2 has Setting the Clock Back to Zero property [9] with parameter $(\alpha_1,\beta_1,\beta_2)$ and $(\alpha_2,\beta_3,\beta_4)$ respectively.

In this case

$$\begin{aligned}h(y)=&\ p_1(\alpha_1+\beta_1)e^{-(\alpha_1+\beta_1)}+p_2(\alpha_2+\beta_3)e^{-(\alpha_2+\beta_3)}+q_1\beta_2e^{-(\beta_2)}+q_2\beta_4e^{-(\beta_4)}\\ &-p_1q_2(\alpha_1+\beta_1+\beta_4)e^{-(\alpha_1+\beta_1+\beta_4)}-q_1p_2(\alpha_2+\beta_2+\beta_3)e^{-(\alpha_2+\beta_2+\beta_3)}\\ &-p_1p_2(\alpha_1+\alpha_2+\beta_1+\beta_3)e^{-(\alpha_1+\alpha_2+\beta_1+\beta_3)}-q_1q_2(\beta_2+\beta_4)e^{-(\beta_2+\beta_4)}\end{aligned} \qquad \text{.....(20)}$$

$$P(S_k<Y)=p_1B_1^k+p_2B_2^k+q_1B_3^k+q_2B_4^k-p_1q_2B_5^k-q_1p_2B_6^k-p_1p_2B_7^k-q_1q_2B_8^k \qquad \text{.....(21)}$$

$$E(T)=\frac{b}{(1-R)q}\left[\begin{array}{l}\frac{p_1}{(1-B_1)}+\frac{p_2}{(1-B_2)}+\frac{q_1}{(1-B_3)}+\frac{q_2}{(1-B_4)}\\ -\frac{p_1q_2}{(1-B_5)}-\frac{q_1p_2}{(1-B_6)}-\frac{p_1p_2}{(1-B_7)}-\frac{q_1q_2}{(1-B_8)}\end{array}\right] \qquad \text{.....(22)}$$

and

$$E(T^2)=\frac{2b^2}{(1-R)^2q^2}\left[\begin{array}{l}\frac{p_1}{(1-B_1)^2}+\frac{p_2}{(1-B_2)^2}+\frac{q_1}{(1-B_3)^2}+\frac{q_2}{(1-B_4)^2}\\ -\frac{p_1q_2}{(1-B_5)^2}-\frac{q_1p_2}{(1-B_6)^2}-\frac{p_1p_2}{(1-B_7)^2}-\frac{q_1q_2}{(1-B_8)^2}\end{array}\right]$$
$$+\frac{2b^2R^2(1-q)}{(1-R)^2q^2}\left[\begin{array}{l}\frac{p_1}{(1-B_1)}+\frac{p_2}{(1-B_2)}+\frac{q_1}{(1-B_3)}+\frac{q_2}{(1-B_4)}\\ -\frac{p_1q_2}{(1-B_5)}-\frac{q_1p_2}{(1-B_6)}-\frac{p_1p_2}{(1-B_7)}-\frac{q_1q_2}{(1-B_8)}\end{array}\right] \quad \ldots\ldots\ldots(23)$$

where

$$B_1=\overline{m}(\alpha_1+\beta_1);B_2=\overline{m}(\alpha_2+\beta_3);B_3=\overline{m}(\beta_2);B_4=\overline{m}(\beta_4);B_5=\overline{m}(\alpha_1+\beta_1+\beta_4)$$

$$B_6=\overline{m}(\alpha_2+\beta_2+\beta_3);B_7=\overline{m}(\alpha_1+\alpha_2+\beta_1+\beta_3);B_8=\overline{m}(\beta_2+\beta_4) \quad \ldots\ldots\ldots(24)$$

(22) together with (23) & (14) give $V(T)$ for the present case.

Model – II: $Y=Min(Y_1,Y_2)$

Suppose Y_1 and Y_2 are as in case (i) of Model – I

In this case, $h(y)=(\alpha_1+\alpha_2)e^{-(\alpha_1+\alpha_2)y}$ ...….....(25)

$$P(S_k<Y)=A_3^k \quad \ldots\ldots\ldots(26)$$

$$E(T)=\frac{b}{(1-R)q}\left[\frac{1}{(1-A_3)}\right] \quad \ldots\ldots\ldots\ldots(27)$$

and

$$E(T^2)=\frac{2b^2}{q^2(1-R)^2}\left[\frac{1}{(1-A_3)^2}\right]+\frac{2b^2R^2(1-q)}{q^2(1-R)^2}\left[\frac{1}{(1-A_3)}\right] \quad \ldots\ldots\ldots\ldots(28)$$

(27) together with (28) & (14) give V(T) for the present case.

Suppose Y_1 and Y_2 are as in case (ii) of Model – I

In this case

$$h(y)=4(\alpha_1+\alpha_2)e^{-(\alpha_1+\alpha_2)y}-2(2\alpha_1+\alpha_2)e^{-(2\alpha_1+\alpha_2)y}$$
$$-2(\alpha_1+2\alpha_2)e^{-(\alpha_1+2\alpha_2)y}+(2\alpha_1+2\alpha_2)e^{-(2\alpha_1+2\alpha_2)y} \quad \ldots\ldots\ldots..(29)$$

$$P(S_k<Y)=4A_3^k-2A_6^k-2A_7^k+A_8^k \quad \ldots\ldots\ldots(30)$$

$$E(T)=\frac{b}{(1-R)q}\left[\frac{4}{(1-A_3)}-\frac{2}{(1-A_6)}-\frac{2}{(1-A_7)}+\frac{1}{(1-A_8)}\right] \quad \ldots\ldots\ldots(31)$$

and

$$E(T^2)=\frac{2b^2}{(1-R)^2q^2}\left[\frac{4}{(1-A_3)^2}-\frac{2}{(1-A_6)^2}-\frac{2}{(1-A_7)^2}+\frac{1}{(1-A_8)^2}\right]$$
$$+\frac{2b^2R^2(1-q)}{(1-R)^2q^2}\left[\frac{4}{(1-A_3)}-\frac{2}{(1-A_6)}-\frac{2}{(1-A_7)}+\frac{1}{(1-A_8)}\right] \quad \text{……..(32)}$$

(31) together with (32) & (14) give V(T) for the present case.

Suppose Y_1 and Y_2 are as in case (iii) of Model – I

In this case

$$h(y)=p_1q_2(\alpha_1+\beta_1+\beta_4)e^{-(\alpha_1+\beta_1+\beta_4)}+q_1p_2(\alpha_2+\beta_2+\beta_3)e^{-(\alpha_2+\beta_2+\beta_3)}$$
$$+p_1p_2(\alpha_1+\alpha_2+\beta_1+\beta_3)e^{-(\alpha_1+\alpha_2+\beta_1+\beta_3)}+q_1q_2(\beta_2+\beta_4)e^{-(\beta_2+\beta_4)} \quad \text{……(33)}$$

$$P(S_k<Y)=p_1q_2B_5^k+q_1p_2B_6^k+p_1p_2B_7^k+q_1q_2B_8^k \quad \text{……..(34)}$$

$$E(T)=\frac{b}{(1-R)q}\left[\frac{p_1q_2}{(1-B_5)}+\frac{q_1p_2}{(1-B_6)}+\frac{p_1p_2}{(1-B_7)}+\frac{q_1q_2}{(1-B_8)}\right] \quad \text{……(35)}$$

and

$$E(T^2)=\frac{2b^2}{(1-R)^2q^2}\left[\frac{p_1q_2}{(1-B_5)^2}+\frac{q_1p_2}{(1-B_6)^2}+\frac{p_1p_2}{(1-B_7)^2}+\frac{q_1q_2}{(1-B_8)^2}\right]$$
$$+\frac{2b^2R^2(1-q)}{(1-R)^2q^2}\left[\frac{p_1q_2}{(1-B_5)}+\frac{q_1p_2}{(1-B_6)}+\frac{p_1p_2}{(1-B_7)}+\frac{q_1q_2}{(1-B_8)}\right] \quad \text{……..(36)}$$

(35) together with (36) & (14) give V(T) for the present case.

Model – III: $Y=Y_1+Y_2$

Suppose Y_1 and Y_2 are as in case (i) of Model – I

In this case

$$h(y)=\frac{\alpha_1\alpha_2}{\alpha_1-\alpha_2}e^{-\alpha_2 y}-\frac{\alpha_1\alpha_2}{\alpha_1-\alpha_2}e^{-\alpha_1 y} \quad \text{……(37)}$$

$$P(S_k<Y)=\frac{\alpha_1}{\alpha_1-\alpha_2}A_2^k-\frac{\alpha_2}{\alpha_1-\alpha_2}A_1^k \quad \text{……..(38)}$$

$$E(T)=\frac{b}{(1-R)q}\left[\frac{\alpha_1}{(\alpha_1-\alpha_2)(1-A_2)}-\frac{\alpha_2}{(\alpha_1-\alpha_2)(1-A_1)}\right] \quad \text{……...(39)}$$

and

$$E(T^2)=\frac{2b^2}{(1-R)^2q^2}\left[\frac{\alpha_1}{(\alpha_1-\alpha_2)(1-A_2)^2}-\frac{\alpha_2}{(\alpha_1-\alpha_2)(1-A_1)^2}\right]+\frac{2b^2R^2(1-q)}{(1-R)^2q^2}\left[\frac{\alpha_1}{(\alpha_1-\alpha_2)(1-A_2)}-\frac{\alpha_2}{(\alpha_1-\alpha_2)(1-A_1)}\right] \quad \ldots\ldots(40)$$

(39) together with (40) & (14) give V(T) for the present case.

Suppose Y_1 and Y_2 are as in case(ii) of Model-I.

In this case

$$h(y)=C_1\alpha_1e^{-\alpha_1y}+2C_2\alpha_1e^{-2\alpha_1y}+C_3\alpha_2e^{-\alpha_2y}+2C_4\alpha_2e^{-2\alpha_2y} \quad \ldots\ldots(41)$$

$$\therefore P(S_k<Y)=C_1(A_1)^k+C_3(A_2)^k+C_2(A_4)^k+C_4(A_5)^k \quad \ldots\ldots(42)$$

$$E(T)=\frac{b}{(1-R)q}\left[\frac{C_1}{(1-A_1)}+\frac{C_3}{(1-A_2)}+\frac{C_2}{(1-A_4)}+\frac{C_4}{(1-A_5)}\right] \quad \ldots\ldots(43)$$

and

$$E(T^2)=\frac{2b^2}{(1-R)^2q^2}\left[\frac{C_1}{(1-A_1)^2}+\frac{C_3}{(1-A_2)^2}+\frac{C_2}{(1-A_4)^2}+\frac{C_4}{(1-A_5)^2}\right]+\frac{2b^2R^2(1-q)}{(1-R)^2q^2}\left[\frac{C_1}{(1-A_1)}+\frac{C_3}{(1-A_2)}+\frac{C_2}{(1-A_4)}+\frac{C_4}{(1-A_5)}\right] \quad \ldots\ldots(44)$$

where

$$\left.\begin{aligned}
C_1&=2+\frac{2\alpha_1}{\alpha_1-2\alpha_2}-\frac{4\alpha_1}{\alpha_1-\alpha_2}\\
C_2&=\frac{4\alpha_1}{2\alpha_1-\alpha_2}-\frac{2\alpha_1}{2\alpha_1-2\alpha_2}-1\\
C_3&=\frac{4\alpha_1}{\alpha_1-\alpha_2}-\frac{4\alpha_1}{2\alpha_1-\alpha_2}\\
C_4&=\frac{2\alpha_1}{2\alpha_1-2\alpha_2}-\frac{2\alpha_1}{\alpha_1-2\alpha_2}
\end{aligned}\right\} \quad \ldots\ldots(45)$$

(43) together with (44)&(14) give V(T) for the present case.

Suppose Y_1 and Y_2 are as in case(iii) of Model-I.

In this case

$$h(y)=D_1(\alpha_1+\beta_1)e^{-(\alpha_1+\beta_1)y}+D_2\beta_2e^{-\beta_2y}+D_3(\alpha_2+\beta_3)e^{-(\alpha_2+\beta_3)y}+D_4\beta_4e^{-\beta_4y} \quad \ldots\ldots(46)$$

$$\therefore P(S_k < Y) = D_1(B_1)^k + D_2(B_3)^k + D_3(B_2)^k + D_4(B_4)^k \qquad \text{.....(47)}$$

$$E(T) = \frac{b}{(1-R)q}\left[\frac{D_1}{(1-B_1)} + \frac{D_2}{(1-B_3)} + \frac{D_3}{(1-B_2)} + \frac{D_4}{(1-B_4)}\right] \qquad \text{.....(48)}$$

$$E(T^2) = \frac{2b^2}{(1-R)^2 q^2}\left[\frac{D_1}{(1-B_1)^2} + \frac{D_2}{(1-B_3)^2} + \frac{D_3}{(1-B_2)^2} + \frac{D_4}{(1-B_4)^2}\right] + \frac{2b^2R^2(1-q)}{(1-R)^2 q^2}\left[\left[\frac{D_1}{(1-B_1)} + \frac{D_2}{(1-B_3)} + \frac{D_3}{(1-B_2)} + \frac{D_4}{(1-B_4)}\right]\right] \qquad \text{.....(49)}$$

where

$$\left.\begin{aligned}
D_1 &= p_1 - \frac{p_1p_2(\alpha_1+\beta_1)}{(\alpha_1+\beta_1-\alpha_2-\beta_3)} - \frac{p_1q_2(\alpha_1+\beta_1)}{(\alpha_1+\beta_1-\beta_4)} \\
D_2 &= q_1 + \frac{q_1p_2\beta_2}{(\beta_2-\alpha_2-\beta_3)} - \frac{q_1q_2\beta_2}{(\beta_2-\beta_4)} \\
D_3 &= \frac{p_1p_2(\alpha_1+\beta_1)}{(\alpha_1+\beta_1-\alpha_2-\beta_3)} + \frac{q_1p_2\beta_2}{(\beta_2-\alpha_2-\beta_3)} \\
D_4 &= \frac{p_1q_2(\alpha_1+\beta_1)}{(\alpha_1+\beta_1-\beta_4)} - \frac{q_1q_2\beta_2}{(\beta_2-\beta_4)}
\end{aligned}\right\} \qquad \text{.....(50)}$$

(48) Together with (49) & (14) give V (T) for the present case.

III. NUMERICAL ILLUSTRATION

The mean and variance of time to recruitment for all the three models are numerically illustrated by varying one parameter and all the other parameters fixed. The effect of nodal parameters on the performance measures namely mean and variance of time to recruitment is shown in the following tables. In all the computation we have taken $\alpha_1 = 0.2$, $\alpha_2 = 0.4$ & $b = 0.1$

Table- 1: Effect of λ, R and q on performance measures E(T) & V(T)

$Y = Max(Y_1, Y_2)$								
λ	q	R	case (i)		case (ii)		Case (iii)	
			E(T)	V(T)	E(T)	V(T)	E(T)	V(T)
0.1	0.1	0.5	3.1667	12.4333	3.6500	15.0031	4.0548	17.2789
0.2	0.1	0.5	4.3333	20.9000	5.3000	26.4422	6.1095	31.5790
0.3	0.1	0.5	5.5000	31.2000	6.9500	40.1175	8.1643	48.7004
0.3	0.2	0.5	2.7500	7.6625	3.4750	9.8556	4.0821	11.9710
0.3	0.4	0.5	1.3750	1.8469	1.7375	2.3770	2.0411	2.8907
0.3	0.6	0.5	0.9167	0.7903	1.1583	1.0178	1.3607	1.2394
0.3	0.1	0.2	3.4375	10.5633	4.3438	13.6185	5.1027	16.6128
0.3	0.1	0.4	4.5833	20.4292	5.7917	26.2956	6.8036	31.9827
0.3	0.1	0.6	6.8750	52.1531	8.6875	66.9839	10.2054	81.1460

Table- 2: Effect of λ, R and q on performance measures E(T) & V(T)

$Y = Min(Y_1, Y_2)$								
λ	q	R	case (i)		case (ii)		Case (iii)	
			E(T)	V(T)	E(T)	V(T)	E(T)	V(T)
0.1	0.1	0.5	2.3333	7.5444	2.6000	8.9144	2.8786	10.4916
0.2	0.1	0.5	2.6667	9.5111	3.2000	12.3778	3.7571	15.9563
0.3	0.1	0.5	3.0000	11.7000	3.8000	16.1900	4.6357	22.1942
0.3	0.2	0.5	1.5000	2.8500	1.9000	3.9525	2.3179	5.4327
0.3	0.4	0.5	0.7500	0.6750	0.9500	0.9406	1.1589	1.3002
0.3	0.6	0.5	0.5000	0.2833	0.6333	0.3969	0.7726	0.5521
0.3	0.1	0.2	1.8750	3.6844	2.3750	5.2020	2.8973	7.3006
0.3	0.1	0.4	2.5000	7.4500	3.1667	10.3881	3.8631	14.3696
0.3	0.1	0.6	3.7500	20.1375	4.7500	27.6481	5.7946	37.5468

Table- 3: Effect of λ, R and q on performance measures E(T) & V(T)

$Y = Y_1 + Y_2$								
λ	q	R	case (i)		case (ii)		Case (iii)	
			E(T)	V(T)	E(T)	V(T)	E(T)	V(T)
0.1	0.1	0.5	3.5000	14.4000	6.0000	30.9556	3.4064	11.0360
0.2	0.1	0.5	5.000	25.5000	10.0000	67.2222	4.5235	16.5591
0.3	0.1	0.5	6.5000	39.1000	14.0000	114.6000	5.6406	22.5457
0.3	0.2	0.5	3.2500	9.6125	7.0000	28.3000	2.8203	5.4954
0.3	0.4	0.5	1.6250	2.3219	3.5000	6.9000	1.4101	1.3033
0.3	0.6	0.5	1.0833	0.9958	2.3333	2.9889	0.9401	0.5479
0.3	0.1	0.2	4.0625	13.3539	8.7500	40.6312	3.5254	7.1412
0.3	0.1	0.4	5.4167	25.6903	11.6667	76.4333	4.7005	14.3876
0.3	0.1	0.6	8.1250	65.1156	17.5000	187.7250	7.0507	38.7178

From the above table, the following observations are presented which agrees with reality**.**

1. When **λ** increases and keeping all the other parameter fixed, the average loss of manhours decreases and the mean time to recruitment increases for all the three cases of models I, II and III .
2. As **R** increases and keeping other parameters fixed, the mean and variance of the time to recruitment increases for all the three models.
3. As **q** decreases and keeping all the other parameter fixed, the mean and variance of the time to recruitment increases in all the models.

IV. CONCLUSION

The model discussed in this paper are found to be more realistic and new in the context of considering (i) separate points (exit points) on the time axis for attrition, thereby removing a severe limitation on instantaneous attrition at decision epochs and (ii) associating a probability for any decision to have exit points. From the organization's point of view, our models are more suitable than the corresponding models with instantaneous attrition at decision epochs, as the provision of exit points at which attrition actually takes place, postpone the time to recruitment.

REFERENCES

[1] Grinold, R.C. and Marshall, K.T. *Manpower Planning Models* (North-Holland, New York, 1979).

[2] Bartholomew, D.J., and Forbes, A., *Statistical techniques for man power planning* (John Wiley and Sons. 1979)

[3] Sathyamoorthy,R. and Elangovan,R., "Shock Model approach to Determine the Expected Time to Recruitment", *Journal of Decision and Mathematika Sciences,Vol.3*, (1998),67 - 78.

[4] Sathyamoorthy,R. and Parthasarathy,S., "On the Expected Time to Recruitment in a Two Graded Marketing Organization", *Indian Association for Productivity Quality and Reliability., 27(1),*(2002), 77-81.

[5] Akilandeswari, M. and Srinivasan,A., "Mean Time to Recruitment for a Two Graded Manpower System when Thresholds Distribution has SCBZ property", *Acta Ciencia Indica, XXXIII M (3),* (2007), 1113-1118.

[6] Mercy Alice, B., "*Some Stochastic Models on the Variance of the Time to Recruitment for a Two Graded Manpower System Associated with a Univariate policy of Recruitment Involving Combined Thresholds*", M.Phil., dissertation, Bharathidasan University,(2009).

[7] Ishwarya, G., "*Stochastic Models on the Time to Recruitment in a Single and Two Graded Manpower System with Two Thresholds for the Organisation*" , M. Phil., dissertation, Bharathidasan University, Tiruchirappalli. (2011).

[8] Gupta,R.D. and Kundu, D., "Exponentiated Exponential Family; An Alternate to Gamma and Weibull", *Biometrica, Vol. 43*, (2001), 117 - 130.

[9] Rao,B.R. and Talwalker,S., "Setting the Clock Back to Zero Property of a Class of life Distribution", *Journal of Statistical Planning and Inference, Vol.24*, (1990), 347 - 352.

[10] Gurland, J., "Distribution of Maximum of the Arithmetic Mean Correlated random variables", *Ann. Math. Statist. Vol.26*, (1955), 294 - 300.

[11] Samuel, K. and Taylor, H.M., *A First Course in Stochastic Processes* (Second Edition, Academic Press, New York, 1975).

[12] Medhi, J., *Stochastic Processes* (New age international publishers, Third Edition, 2009).

[13] Devi, A. and Srinivasan,A., "Variance of Time to Recruitment for a Single Grade Manpower System with Different Epochs for Decisions and Exits", *International Journal of Research in Mathematics and Computations,Vol.2,*(2014),23 - 27.

[14] Devi, A. and Srinivasan, A., "Probabilistic Analysis on Time to Recruitment for a Single Grade Manpower System with Different Epochs for Decisions and Exits", *International Journal of Revolution in Science and Humanity, Vol.2, No. 4*, (July 2014), 59 – 64.

[15] Devi, A. and Srinivasan, A., "Expected Time to Recruitment in a Single grade Manpower System with Different Epochs for Decisions and exits having Correlated Inter-decision times Using Univariate Policy of Recruitment", *Asian Academic Research Journal of Multidisciplinary, Vol.1, No. 23*, (July 2014), 571 – 580.

[16] Devi, A. and Srinivasan, A., "Variance of Time to Recruitment for a Single grade Manpower System with Different Epochs for Decisions and exits having Correlated Inter-decision times", *Annals of Pure and Applied Mathematics, Vol.6, No. 2*, (2014), 185 – 190.

[17] Ishwarya G., and Srinivasan, A., "A Stochastic Model on Time to Recruitment in a Two Grade Manpower System with Different Epochs for Decisions and exits", *Proceedings of the International Conference on Mathematics and its Applications, University College of Engineering, Villupuram, Anna University, Chennai*. (2014). 1160 – 1172.

DESIGN OF ADVANCED HIGH-PERFORMANCE BUS TO INCREASE THE BIT RATE OF SECURED DIGITAL HOST CONTROLLER

S.Mathan Prasad[1], E.Abinaya[1], Dr. D. Somasundareswari[2]

[1,2] PG Student/ VLSI Design, SNS College of Technology, Coimbatore, (India)

[2]Dean and HOD, Department of ECE, SNS College of Technology, Coimbatore, (India)

ABSTRACT

Portable storage devices are becoming popular and growing rapidly. These devices can store and acquire information wherever and whenever you need. The important applications of portable storage devices are to make backup copies of important data, to share information between different computers or persons, and to secure information which are extremely confidential. But the drawback of handling these portable devices is, it has less read and write speed while transferring the data. This drawback can be overcome by increasing the bit rate between SD Host system and SD Memory card sockets. By changing the FSM control of AHB master, the speed of read and write operation is increased. Due to this the FIFO is controlled. In this paper the control signals between Advanced High-performance Bus Master and slave using Burst Transfer method and its performance is analyzed. The Burst Transfer method has some of the processing delay in its FSM. By using Split Transaction method the delay process that occurs in Burst Transfer method is rectified and increased the speed of the bit rate between SD Host system and SD Memory socket.

Keywords : Advanced High-performance Bus, Bit-rate, Finite State Machine, Host controller, Secured digital.

I INTRODUCTION

With the increasing consumer digital content, demand for high capacity digital storage is increasing rapidly. Today, portable storage media are widely used in all mobile phones, digital cameras, camcorders, and in many multimedia devices. Different memory formats like Flash, Secure Digital (SD), Compact Flash, Universal Serial Bus (USB), and Multimedia Card (MMC) are available in the market to store the digital contents. Of all these formats, SD provides many advantages over other formats. Secure Digital (SD) is a Non-volatile memory card format developed by the SD CARD Association (SDA) for use in portable devices. SD cards provide high storage capacity, higher transfer speed, and interoperability with Personal Computer (PC) - related devices and multimedia products.

The Host Controller handles SDIO/SD Protocol at transmission level, packing data, adding cyclic redundancy check (CRC), Start/End bit, and checking for transaction format correctness. The Host Controller provides Programmed IO method and DMA data transfer method. In programmed IO method, the ARM processor transfers data using the Buffer Data Port Register.

II. ARCHITECTURE OF SD HOST CONTROLLER

The SD3.0 / SDIO3.0 / eMMC4.5 Host Controller (3MCR Host Controller) is a Host Controller with an ARM processor interface. This product conforms to SD Host Controller Standard Specification Version 3.00. The block diagram of Host Controller is shown below in fig 1.

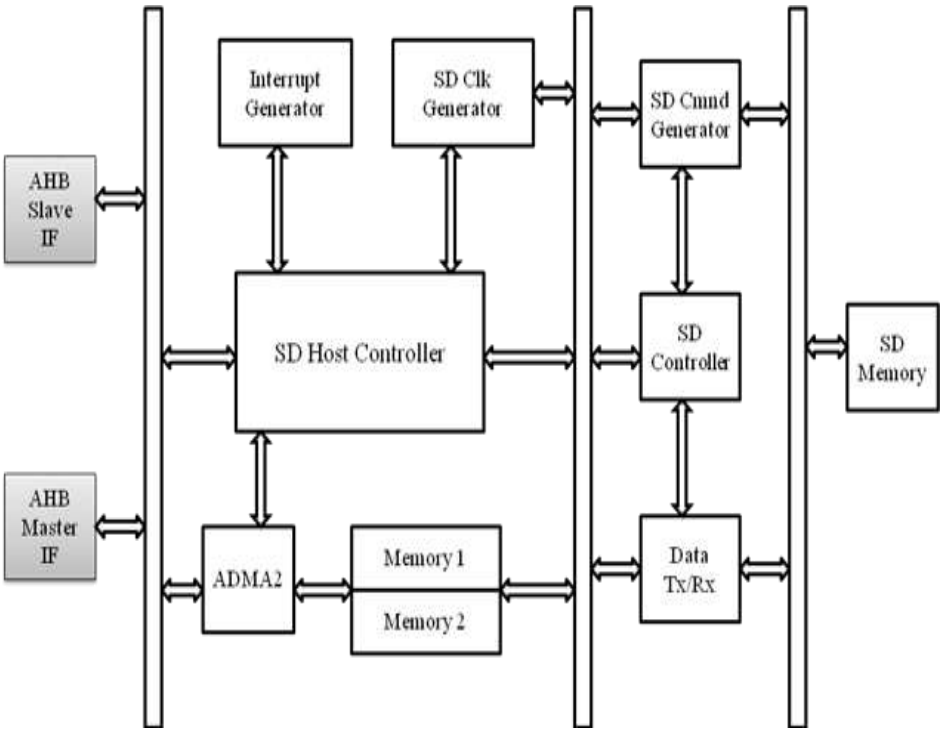

Fig.1 Block Diagram of SD Host Controller

2.1 Data FIFO

The SD/SDIO Host Controller uses one 1k dual port FIFO for performing both read and write transactions. During a write transaction (data transferred from ARM Processor to SD3.0 / SDIO3.0 / eMMC4.41 card), the data will be filled in to the first and second half of the FIFO alternatively. When data from first half of FIFO is transferring to the SD3.0 / SDIO3.0 / eMMC4.41 card, the second half of FIFO will be filled and vice versa. The two halves of the FIFO's are alternatively used to store data which will give maximum throughput. During a read transaction (data transferred from SD3.0 / SDIO3.0 / eMMC4.41 card to ARM Processor), the data from SD3.0 / SDIO3.0 / eMMC4.41 card will be written in to the two halves of the FIFO alternatively. When data from one half of the FIFO is transferring to the ARM Processor, the second half of the FIFO will be filled and vice versa and thereby the throughput will be maximum. If the Host controller cannot accept any data from

SD3.0 / SDIO3.0 / eMMC4.41 card, then it will issue read wait to stop the data transfer from card or by stopping the clock.

2.2 Data Control Logic

The DAT [0-7] control logic block transmits data on the data lines during write transaction and receives data from the data lines during read transaction. The DAT [0-7] control logic block transmits data in the data lines on posedge and negedge of the SD CLOCK during DDR mode of operation. The DATA [0-7] receiver block receives/ samples the data on the data lines in both posedge and negedge of the SD CLOCK during DDR mode of operation. The Command control logic block sends the command on the cmd line and receives the response coming from the SD3.0 / SDIO3.0 / eMMC4.41 card.

III. ADVANCED HIGH PERFORMANCE BUS

The APB is part of the AMBA hierarchy of buses and is optimized for minimal power consumption and reduced interface complexity. The AMBA APB appears as a local secondary bus that is encapsulated as a single AHB or ASB slave device. APB provides a low-power extension to the system bus which builds on AHB or ASB signals directly.

Fig 2 shows a single master AHB-Lite system design with one AHB-Lite master and three AHB-Lite slaves. The bus interconnect logic consists of one address decoder and a slave-to-master multiplexor. The decoder monitors the address from the master so that the appropriate slave is selected and the multiplexor routes the corresponding slave output data back to the master.

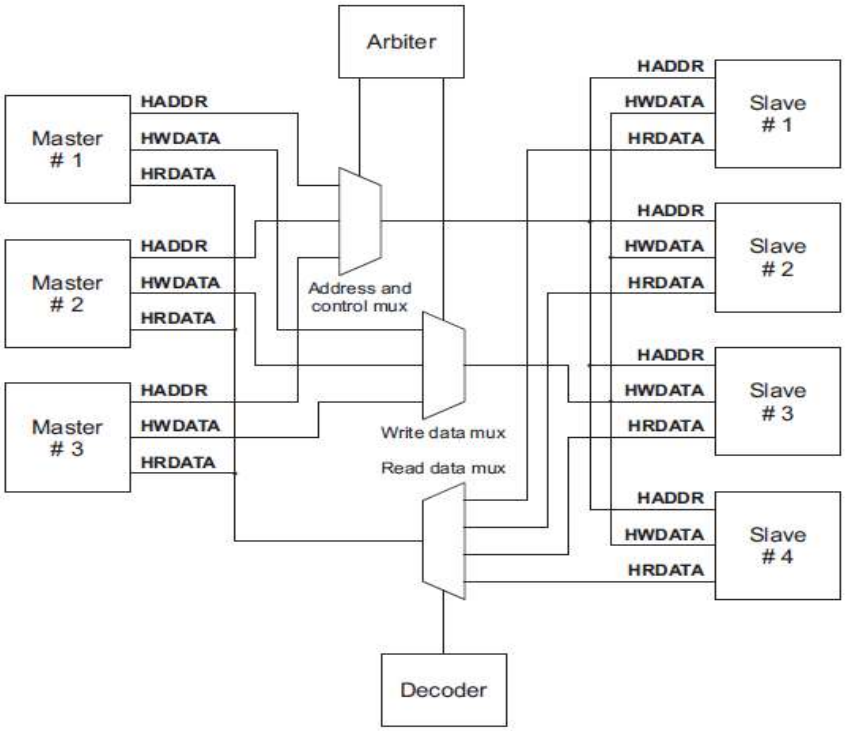

Fig.2 AHB-Lite Block Diagram

3.1 Advanced High-performance Bus Master

A bus master is able to initiate read and write operations by providing an address and control information. Only one bus master is allowed to actively use the bus at any one time.

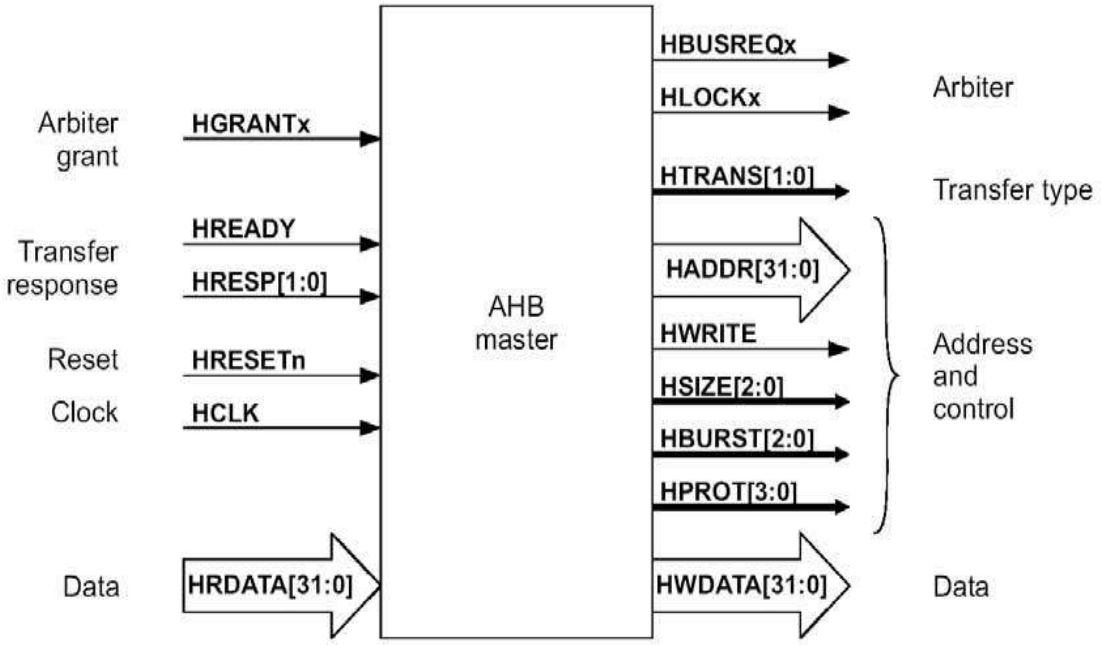

Fig. 3 AHB-Master Interface Diagram

3.2 Advanced High-performance Bus Slave

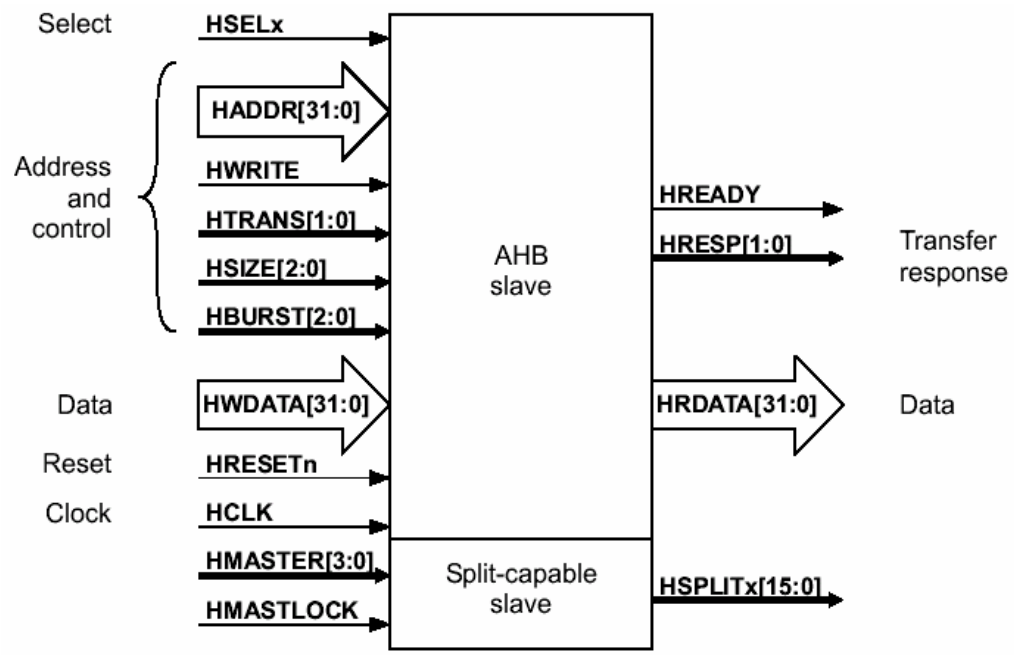

Fig. 4 AHB-Slave Interface Diagram

An AHB-Lite slave responds to transfers initiated by masters in the system. The slave uses the HSELx select signal from the decoder to control when it responds to a bus transfer.

The slave signals back to the master:

- The Success
- Failure
- Or Waiting for the Data transfer

IV.FINITE STATE MACHINE FOR AHB

Main component in the AMBA system is the master that can initiate the read or write transfer to any slave so it is imperative that master is properly designed for an AHB system to work. In addition AHB master implementation has to support advance features like burst transfers defined in the specification. So here in Fig 5 finite state machine is shown which support the features in the specification.

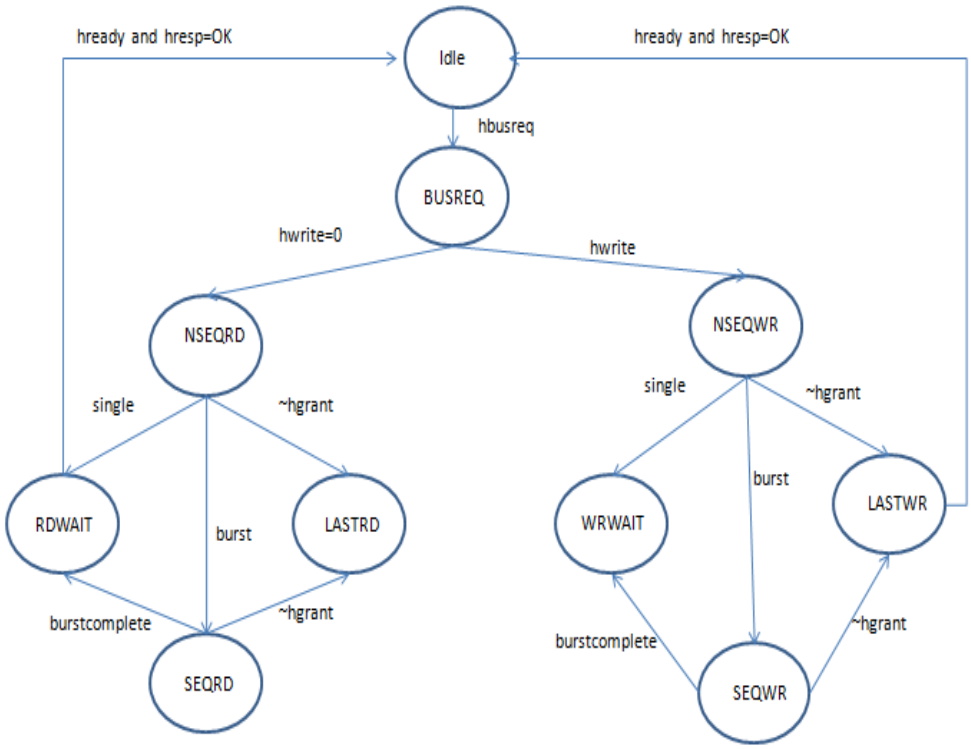

Fig.5 Finite State Machine of AHB

V. RESULTS

5.1 Input/Output for FSM of AHB

The input/output wave form for the Finite State Machine fig 5, is shown in fig 6.

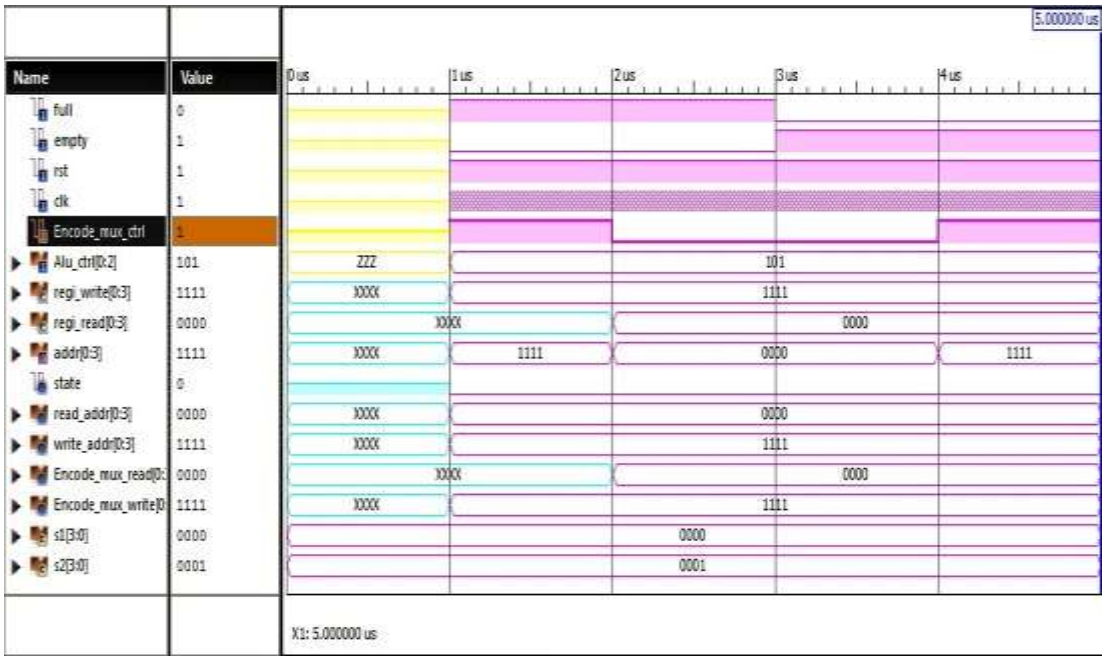

Fig.6 Output for FSM of AHB

After designing the finite state machine, any hardware description language is used to implement it and check it functionality for correctness. In this Project, the state machine is implemented in Verilog and Xilinx simulation tool is used to simulate the design and generate the waveforms.

5.2 FIFO Output

Fig 9 is the finalized simulated output wave form for the designed AHB using Split transaction method.

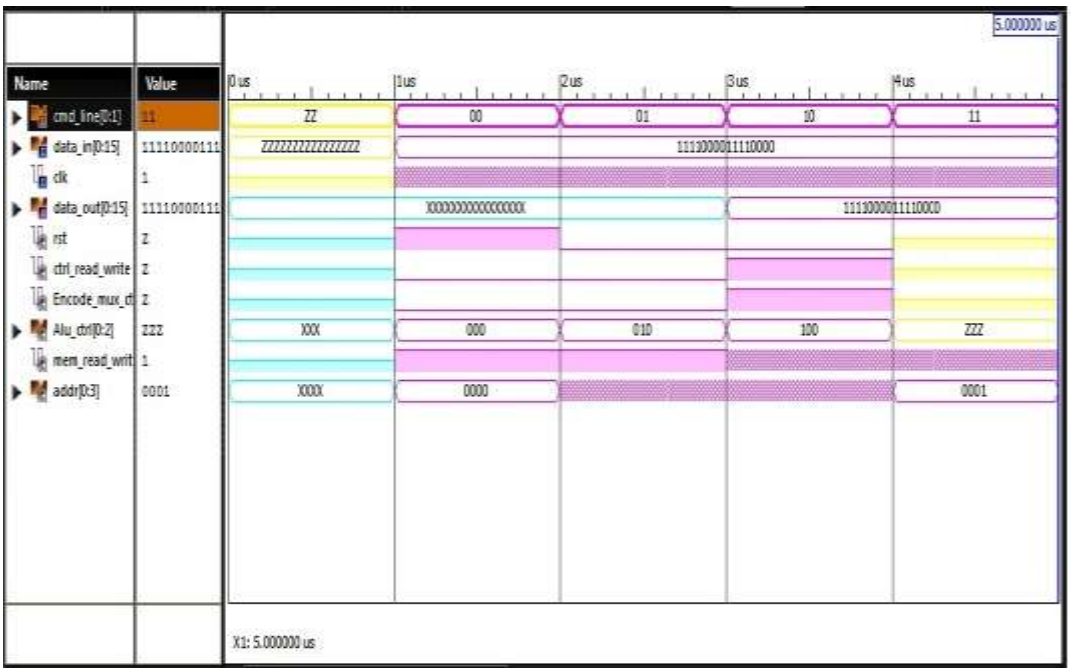

Fig 9 AHB FIFO Wave form

VI.CONCLUSION

In this paper the bit rate of Secured Digital Host Controller is increased by 2 Mbps using Split Transfer when compared to Burst Transfer. For a master that hands its request to interface, transaction is completed at the moment the request in handover to controller and bus is free. Thus not only the SDRAM memory is getting efficient but AHB bus utilization also enhances as per our design. The testing results shows 91.66% of reduced delay with FIFO when compared to the latency produced with FIFO, which is nothing but the in-built memory used within the SDRAM controller to improve its performance. In future, the algorithm used in the design of AHB Master Finite State Machine will be reconstructed in order to increase the bit rate upto the expected of 16 Mbps speed.

REFERENCES

[1] Pravin S. Shete, Dr. Shruthi Oza, "Design of an Efficient FSM for an Implementation of AMBA AHB Master", IJARCSEE volume 4, Issue 3, March 2014.

[2] Jaikiran l, Prakash biswagar, Theiventhiran Murugan, "Functional verification of Secured Digital Host Controller", IJESS, volume 3, Issue 1, 2013.

[3] Bhaumik Vaidya, Anupam Devani, "Design of an Efficient Finite State Machine for the Implementation of AMBA AHB Master", JIKRCE, volume 2, Issue 2, Nov 2013.

[4] Bhavana L. Mahajan, Ashiwale, Kshitija S. Patil, "Implementation of AHB protocol using FPGA", IJESAT, volume 2, Issue 4, Auguat 2012.

[5] Technical Committee SD Association. (2013): "SD Specifications Part A2 SD Host Controller Simplified - Specification Version 3.00". Retrieved February 25, 2013 from SD website: http://www.sdcard.org.

[6] Technical committee SD association. (2012): "SD Specifications Part 1Physical Layer Simplified Specification Version 3.01." Retrieved February 18, 2012 from SD website: http://www.sdcard.org.

[7] "AMBA Advanced High Performance Bus (AHB) Protocol specification". http://www.arm.com/

[8] Technical Committee SD Association. (2011): "SD Specifications Part 1 NFC (Near Field Communication) Interface Simplified Addendum Version 1.00". Retrieved November 08, 2011 from SD website: http://www.sdcard.org.

[9] AHB Example AMBA System. http://www.arm.com/

[10] "SD Specifications Part E1 SDIO Simplified Specification Version 3.00." February 25, 2011 from SD website: http://www.sdcard.org.

SANTIAGO DOESN'T DO DIFFERENT THINGS BUT DOES THINGS DIFFERENTLY

D.Vijaya Lakshmi[1], N. Pavan Kumar[2], J. B. Manoja Devi[3]

[1] *Sr. Asst. Prof., Vishnu Institute of Technology, Bhimavaram, A.P. (India)*

[2, 3] *Asst. Prof., Vishnu Institute of Technology, Bhimavaram, A.P. (India)*

ABSTRACT

This paper focuses on a versatile personality of Brazilian renowned author Paulo Coelho's hero Santiago, the protagonist of the novel The Alchemist. Paulo Coelho's depiction of the theme of quest in this novel substantiates the essential attributes of an individual. In Santiago's spiritual journey, he encounters many a character who polish his intrinsic talent. Along the way, he trysts with interpretations, characters, opportunity, love, adversity and learns a lot about himself and the ways of the world. Santiago proves that he can fit into any environment because of his life-enhancing qualities such as positive attitude, interpersonal skills, goal setting, self-esteem, subconscious mind, motivation, and success. Paulo Coelho meticulously imparts all these qualities in Santiago. These life skills empower Santiago to take a positive action and to succeed in finding the treasure. Spencer Johnson, M.D., co-author of The One minute Manager says: "An entrepreneurial tale of universal wisdom we can apply to the business of our own lives".

Keywords*: Journey, Positive Attitude, Interpersonal Skills, Goal Setting, Self-Esteem*

I. INTRODUCTION

This paper focuses on a versatile personality of Brazilian renowned author Paulo Coelho's hero Santiago, the protagonist of the novel *The Alchemist*. Paulo Coelho's depiction of the theme of quest in this novel substantiates the essential attributes of an individual. In Santiago's spiritual journey, he encounters many a character who polish his intrinsic talent. Along the way, he trysts with interpretations, characters, opportunity, love, adversity and learns a lot about himself and the ways of the world. Santiago proves that he can fit into any environment because of his life-enhancing qualities such as positive attitude, interpersonal skills, goal setting, self-esteem, subconscious mind, motivation, and success. Paulo Coelho meticulously imparts all these qualities in Santiago. These life skills empower Santiago to take a positive action and to succeed in finding the treasure.

Spencer Johnson, M.D., co-author of The One minute Manager says: "An entrepreneurial tale of universal wisdom we can apply to the business of our own lives". Shiv Khera suggests some character traits of an individual. He says that every individual should have some of the essential qualities to succeed in his/her life. He narrates each quality with real time examples. Paulo Coelho clearly shows all these qualities in Santiago in The Alchemist. Santiago an Andalusian shepherd boy starts his journey from his home town Spain to Egyptian pyramids. Paulo Coelho's depiction of the theme of the quest in this novel substantiates the essential attributes of an individual. In order to perform well his journey of life, Santiago exhibits high levels of life skills and soft skills in dealing with animals, people, things etc. Basically he possesses adaptability, flexibility, commitment and perseverance.

II. GOAL SETTING

Shiv Khera in You Can Win says that knowledge helps a person to reach his goal. Sometimes people confuse goals with dreams. Without proper planning no dream can become a goal. Only with the innate passion of the person can turn dreams into reality. Every individual has to develop strategies to accomplish his/her goals. For example:

"An ancient Indian sage was teaching his disciples the art of archery. He put a wooden bird as the target and asked them to aim at the eye of the bird. The first disciple was asked to describe what he saw. He said, "I see the trees, the branches, the leaves, the sky, the bird and its eye.." The sage asked this disciple to wait. Then he asked the second disciple the same question and he replied, "I only see the eye of the bird." The sage said, "Very good, then shoot." The arrow went straight and hit the eye of the bird". (130-131)

Similarly Santiago turns his dreams into his goal. His family is a small farm family. They work hard throughout the day like sheep work for food and water. His parents want him to become a priest. But he sets his goal to become a traveler when he was a child.

"He had studied Latin, Spanish, and theology. But ever since he had been a child, he had wanted to know the world, and this was much more important to him than knowing God and learning about man's sins. One afternoon, on a visit to his family, he had summoned up the courage to tell his father that he didn't want to become a priest. That he wanted to travel". (8)

He argues with his father and convinced him to become a shepherd as the only people who travel are shepherds. His father blessed him to travel the world which is huge and inexhaustible.

III. POSITIVE ATTITUDE

William James of Harvard University says: "The greatest discovery of my generation is that human beings can alter their lives by altering their attitudes of mind."(3). Attitude of a person is noticed at his childhood. This attitude includes three components: an affect (a feeling), cognition (a thought or belief), and behavior (an action). Santiago possesses all these components in his journey of life in different aspects.

The first component is feeling: With the consent of Santiago's father Santiago becomes a shepherd. He enjoys his life as a shepherd as it allows him to travel. They were content with just food and water and also they generously give of their wool and once in a while their meat. Santiago says that "they are so used to me that they know my schedule."(4) So they become a part and parcel of his life.

The second component is cognition: Santiago is going to meet the merchant's daughter shortly. He has got impressed by her physical appearance. "He recognized that he was feeling something he had never experienced before: the desire to live in one place forever". (6) The last component of attitude is: Santiago is motivated by the words of the old king Melchizedek. He leaves the thought of sticking to a place and stars his journey to the Egyptian Pyramids where the treasure is located in the words of the old king.

He arrives in Africa and is robbed by somebody. He feels sorry for himself and lamenting that his life has changed so suddenly and drastically. He recollects the words of the old king and obtains energy. Santiago says to himself. "I promised that I would make my own decisions," (43) I'm an adventurer, looking for treasure."(44) Santiago cultivates the discipline and dedication to practice the principles of positive attitude.

IV. INTERPERSONAL SKILLS AND SELF ESTEEM

These two skills are intertwined with each other. Self-esteem is an emotional evaluation of an individual. It shows about the worth and worthiness of an individual. If any individual likes to be a self-esteemed person he/she has to sustain these interpersonal skills. Communication, listening, understanding and interaction with the other person are called interpersonal skills. Subconsciously these interpersonal skills are developed from the childhood. With a little time and effort one can develop them. Benjamin Franklin says, "When you are good to others, you are best to yourself."(89) The ability to convince and influence with the ideas on the mind of the other person is really a skill. Santiago is not a selfish person but a self-interested and self-esteemed person. This self-interest intensifies him to find his hidden treasure. Self-interest certainly leads to triumph/victory.

Santiago is an exemplified person for his interpersonal skills. He communicates his idea of becoming a shepherd to his parents. They are convinced and bless him. Santiago's father gives a pouch with three ancient Spanish gold coins. He says to his son, "I found these one day in the fields. I wanted them to be a part of your inheritance. But use them to buy your flock".(9)

Santiago understands the words of the old king when he says about his Personal Legend and Soul of the World. The old king charges him to handover one tenth of the sheep he has got to say about the hidden treasure. Santiago brings them to the old king. Here Santiago shows his interpersonal skills.

"Then the old man began to inspect the sheep, and he saw that one was lame. The boy explained that it wasn't important, since that sheep was the most intelligent of the flock, and produced the most wool".(30)

His interaction with Fatima leaves him in the world of pleasure. He loves her at first sight. He proposed the same to her. She convinces with his words. One day she says to him:

"You told me that you loved me. Then, you taught me something of the universal language and the Soul of the World. Because of that, I have become a part of you."…"I have been waiting for you here at this oasis for a long time."(101)

He starts listening to his heart with the inspiration of the alchemist. He learns to communicate with nature. Santiago shows his sorcery of transforming himself into the wind to all the desert people and attracts them.

"The following day, the general bade the boy and the alchemist farewell, and provided them with an escort party to accompany them as far as they chose."(161)

V. MOTIVATION

Motivation comes from a person's belief. Motivation is different from inspiration. Inspiration is only thought where as motivation is action. It inspires and encourages the human beings. It persuades the person into action. It is extremely powerful and it is a driving force to proceed further. People with this motivation become more dynamic, personally and professionally. Motivation comes from a desire to succeed.

Santiago is motivated by five important characters such as Melchizedek, who claims to be the King of Salem, Crystal merchant, who makes him survive in a place, Fatima, whom he loves most, the alchemist, who guides him to connect with the mystical Soul of the World and ultimately the thief, who says about his own dream. Firstly Melchizedek introduces himself to Santiago. He clearly makes him understand that the sheep, merchant's daughter and the fields of Andalusia are only steps to reach his destiny. He inspires him to quest for the treasure, which leads him to meet his Personal Legend. The old king says:

"It's a force that appears to be negative, but actually shows you how to realize your destiny. It prepares your spirit and your will, because there is one great truth on this planet…And when you want something, all the universe conspires in helping you to achieve it."(22-23)

Secondly crystal merchant brings a change in Santiago's mind. He is simply Santiago's foil. Santiago is not inspired by him. But he observes that he is not going to live like this crystal merchant. Though he is not bad, his concepts about his Personal Legend are different. He cannot be able to take a further step in his life. Santiago learns from him that he will not lead his life like an ordinary man but he wants to be something extraordinary.

Thirdly Fatima encourages him to go in search of his treasure. She prompts him that he says about his dreams, about the old king, the omens and his treasure. So she fears nothing, because those omens that brought him to her. She gives him the assurance that she will wait for him till he comes back to her after finding the treasure.

Last but not the least the alchemist stimulates Santiago to meet his destiny of finding the treasure. He says, "Continue in the direction of the Pyramids, and continue to pay heed to the omens. Your heart is still capable of showing you where the treasure is."(139) Finally, Santiago is motivated by the thief. He says:

"Two years ago, right here on this spot, I had a recurrent dream, too. I dreamed that I should travel to the fields of Spain and look for a ruined church where shepherds and their sheep slept. In my dream, there was a sycamore growing out of the ruins of the sacristy, and I was told that, if I dug at the roots of the sycamore, I would find the sacristy, and I was told that, if I dug at the roots of the sycamore, I would find a hidden treasure. But I'm not so stupid as to cross an entire desert just because of a recurrent dream."(172)

VI. SUBCONSCIOUS MIND

Subconscious mind is like a magnet as it attracts all things that vibrate with the frequencies of its beliefs. This subconscious mind is the treasure home of previous experiences, faith, belief, skills etc. Santiago rises to the expectations of the alchemist because of his subconscious mind. Santiago meets number of persons in his journey. The more Santiago learns about his human mind the more he will use it to enhance his life. He uses different means to develop his subconscious mind. In the part of it he guesses the things easily and starts listening to his intuition and makes predictions.

The alchemist makes him understand listening to his heart. He says, "Wherever your heart is, that is where you'll find your treasure."(135) At a particular juncture in the novel Santiago says to the alchemist about his fear of suffering. But the alchemist says:

"Tell your heart that fear of suffering is worse than the suffering itself. And that no heart has ever suffered when it goes in search of its dreams, because every second of the search is a second's encounter with God and with eternity." (136)

VII. SUCCESS

Shiv Khera says to The Hindu, "Positive thinking alone cannot guarantee success. "It is a supplement, not a substitute for your action plan. Your positive action combined with positive thinking results in success." Santiago's school, family, the sheep, merchant's daughter, gypsy woman, the old king, the crystal merchant, Fatima, the alchemist, the chief, the thief -everybody in this novel helps him to reach towards the direction of

success. At first he starts his journey in search of treasure but this materialistic journey turns into spiritual journey. Santiago says to himself and thinks about his dream and life in future: "It's the possibility of having a dream come true that makes life interesting."(11) Santiago becomes helpless and hopeless in the novel in many a incident but he doesn't forget his goal which makes him undergo the pains and also the gains. Santiago proves that any dream will come true only with the individual industry. Earl Nightingale says, "Success is the progressive realization of a worthy goal".

VIII. CONCLUSION

What Shiv Khera says, that Santiago does in his life. Due to this reason, he becomes the outstanding personality in the history of English literature. Not only Santiago, any individual with these theories to follow and practice in their life can be a successful person. 'A tree is known by its fruit' is a well know proverb which will be apt for Paulo Coelho and his work *The Alchemist.*

REFERENCES

[1] Khera, Shiv. *You Can Win.* Viewed on 18th September, 2013. Retrieved from http://sarsobiz.in/wp-content/uploads/2013/07/You-Can-Win-by-Shiv-Khera.pdf

[2] Allport, G. W. (1935). *Attitudes*. In Murchison C. (Ed.), Handbook of social psychology. Worcester, MA: Clark University Press.

[3] Nathaniel Branden. Cómo mejorar su autoestima. 1987. Versión traducida: 1990. 1ª edición en formato electrónico: enero de 2010. Ediciones Paidós Ibérica. ISBN 978-84-493-2347-8.

[4] The Hindu, 4 March 2013 Shiv Khera's formula for success Chitradeepa A.