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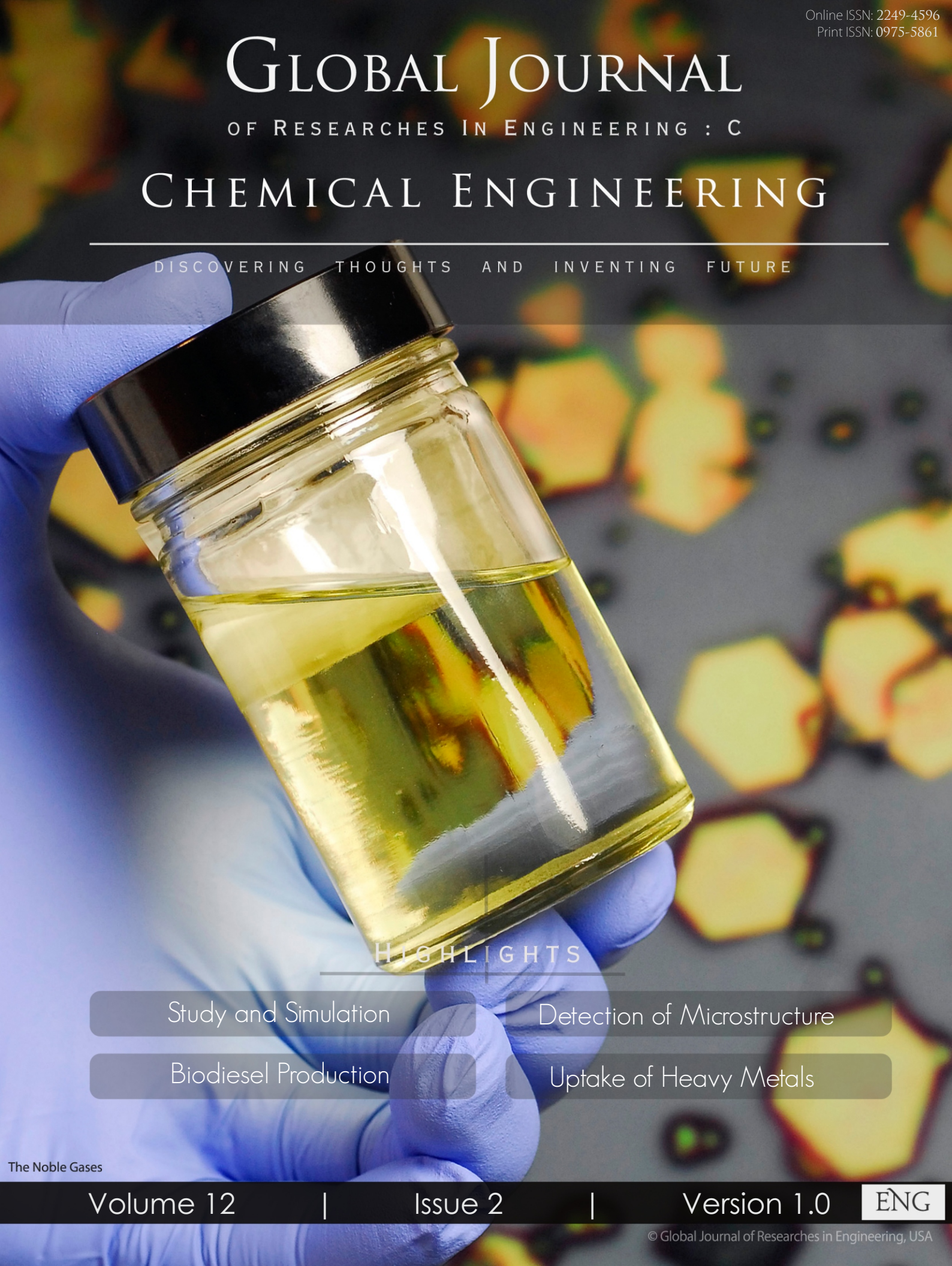

HIGHLIGHTS

- Study and Simulation
- Detection of Microstructure
- Biodiesel Production
- Uptake of Heavy Metals

The Noble Gases

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The Studying of Declining Reservoir Pressure on Natural Gas Sweetening Process: A Case Study and Simulation

By R.K.Abdulrahman & I.M. Sebastine
Koya University, Kurdistan region-Iraq

Abstract - Natural gas is considered as one of the most popular source of energy in recent era and future as well. However, raw natural gas usually contents several of non-hydrocarbon components for instance, hydrogen sulphide and carbon dioxide. Indeed, these impurities are undesirable compounds and cause many problems for example, corrosion and environment pollution. Moreover, amine gas sweetening process is considered the most popular technology to remove acid gases from natural gas stream. However, when the hydrocarbons reservoir pressure declines, new wells are drilled to maintain production and enhanced oil recovery methods are also applied at the end age of the reservoir. As a result, the declining of the reservoir pressure leads to decline the operation pressure for the amine contactor tower and it may lead to significant effects on gas sweetening process efficiency and performance. Therefore, this study aims to simulate gas-sweetening process for given raw natural gas stream that it contents high quantity of acid gases by using Aspen HYSYS simulator program and then examine the effects of declining reservoir pressure on the sweetening process. The case study gas stream operation pressure is about 7000 Kpa. However, the study found that when the sour gas pressure declined that will effect acid gases loading in amine solution.

Keywords : *Natural gas sweetening, reservoir pressure, amine solution, process simulation, Aspen Hysys, process efficiency.*

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Some Nomenclature

CO_2 Carbon dioxide
DEA Dimethylamine
MEA Monomethylamine
H_2S Hydrogen sulfide

I. Introduction

The demand of natural gas in recent decade has been dramatic. In fact, natural gas poses a huge rule in the recent world economy and development. However, natural gas usually contains several impurities for instance, acid gases that it need to be removed from natural gas to meet the gas pipelines specifications. Stewart and Arnold (2011) note that gas contracts restrict H_2S content about 4ppm and CO_2 about 2% in natural gas stream. Thus, several gas sweetening are develop in order to remove acid gases from raw natural gas stream for example, chemical absorption, solid bet sweetening method and physical absorption method. However, amine gas sweetening may consider the most common process among natural gas sweetening method. Indeed, amine gas sweetening process has many advantages for instance, continues process, the ability to regenerate the process solvent. However, any amine process has several operation conditions for instance amine contactor pressure and amine solution concentration. In fact, amine contactor pressure is considered one of the most important amine process operation condition. Moreover, any declining of absorber pressure may affect the whole process. Therefore, a case study for raw natural gas stream will be examined by Aspen HYSYS simulation and the operation pressure of amine absorber tower will be examined by changing the value of amine contactor pressure several time and then transfer the results to MS excel to find out the results of effect of declining reservoir pressure on amine process. Moreover, the given gas stream may consider quite sour gas because is contents a high quantities of H_2S about (5.3%) and CO_2 about (4.4%). However, amine gas sweetening process will be able to reduce acid gases contents by using a suitable amine solvent type.

II. Amine Process Description

This method is also included several processes that utilized different chemical solvents:

- MEA(MonoEthanolAmine) process
- DEA(DiEthanolAmine) process
- MDEA(MetheylDiEthanolAmine) process
- DGA(DiGlycolAmine) process
- Hot potassium carbonate process

The chemical reaction of amines with H2S and CO2 Could be summarized below:

2RNH2 + H2S = (RNH3)2S

2RNH2+ CO2 = RNHCOONH3R *R= mono,di,tri-Ethanol

Chemical solvent method may consider the most remarkable and successful method in Natural gas sweetening field. Moreover, it may consider number one in most gas plant around world. Indeed, this method is utilized an aqueous solution of a weak base to

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chemically react with and absorb the acid gases in the natural gas stream (Stewart and Arnold, 2011). In fact, these chemical solvents possess high affinity toward acid gases. The aqueous solution could be regenerating easily and recirculate to the process. The chemical solvent method is mainly utilized either Amine or carbonate solution to achieve the sweetening process. The amine gas sweetening process is considered a continues process and figure (1) shows the general flow diagram for amine gas sweetening plant. Firstly, sour gas stream is usually enters to scrubber to remove sour gas constants. Secondly, sour gas enters to the bottom side of amine absorber tower and flow countercurrent to amine solvent and Sweet gas will leave the top of the contactor tower and need to be processed to dehydration process to remove saturated water. Moreover, Dirty or rich amine will leave bottom of contactor tower and need to be regenerate. Finally, Amine stripping tower (regenerator) is used to regenerate the dirty amine hot lean amine need to be cooled therefore it flows to amine heat exchanger and then back to contactor tower. The brief of amine process could be described as following:

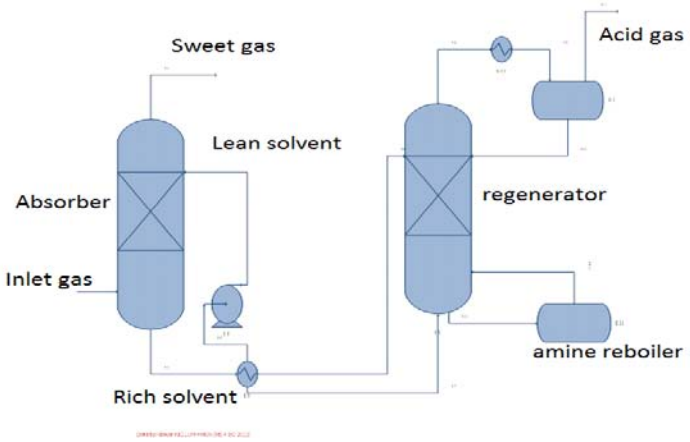

Figure 1: General flow diagram for Amine plant.

III. Case Study

The case study gas composition is shown in table (1). It seems that the gas has high content of acid gases. However, the gas analyzed on dry basis. Therefore, gas water content should be calculated.

Table 1 : Given raw natural gas compositions and operation conditions.

Case Study data		Component	Mole%
		H_2S	5.38
		CO_2	4.48
		N_2	0.11
		CH_4	63.35
		C_2H_6	13.9
Flow rate	120,000 $stdm^3/hr$	C_3H_8	6.03
NG density	0.65 Kg/m^3	$i\text{-}C_4H_{10}$	1.36
Gas SG	0.67	$n\text{-}C_4H_{10}$	2.44
Pressure	7000 K.pa	$i\text{-}C_5H_{12}$	1.03
Temperature	38 C°	$n\text{-}C_5H_{14}$	0.73
Max. Ambient temperature	38 C°	C_6H_{14}	1.19

Natural gas water content can estimate by using McKetta-Wehe Chart [3]. Therefore, water content is about 1000Kg/MMstd.m^3= 128.265 Kg/hr.

Now, the new Natural gas composition could be calculated and summarized in table (2):

Table 2 : Natural gas compositions and quantities.

Component	Mole%	RMM	Kmole/hr	Kg/hr	Mole%
H_2S	5.38	34.076	288.03426	9815.056	5.372849
CO_2	4.48	44.01	239.85009	10555.8	4.474045
N_2	0.11	28.02	5.8891764	165.0147	0.109854
CH_4	63.35	16.02	3391.6302	54333.92	63.26579
C_2H_6	13.9	30.07	744.17775	22377.42	13.88152
C_3H_8	6.03	44.09	322.83394	14233.75	6.021985
i-C_4H_{10}	1.36	58.123	72.811636	4232.031	1.358192
n-C_4H_{10}	2.44	58.123	130.63264	7592.761	2.436757
i-C_5H_{12}	1.03	72.15	55.144106	3978.647	1.028631
n-C_5H_{14}	0.73	72.15	39.082716	2819.818	0.72903
C_6H_{14}	1.19	86.177	63.710181	5490.352	1.188418
H_2O	-	18	7.1258541	128.2654	0.132922
Total	100		5360.9226	135722.8	100

a) Steady sate simulation

The amine gas sweetening plant is simulated by using the latest version of Aspen HYSY V.7. The DEA solution is used as an aqueous absorbent to absorb acid gases from sour gas stream. The first step of simulation could be done by adding the gas stream compositions and conditions which it same data of this case study. Moreover, Hysys fluid package should be carefully chosen which it should be (Amine Pkg) as shown in fig (2).

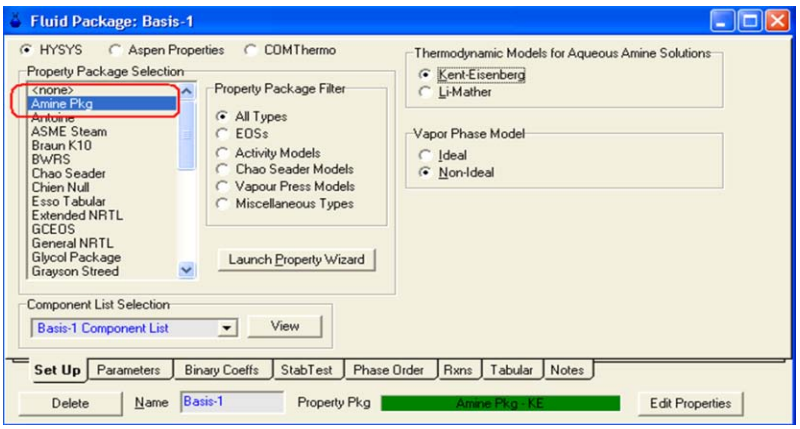

Figure 2 : Hysys fluid package menu

After achieving above, the simulation environment is entered. Moreover, simulation environment may consider the main simulation area, which it deals with the plant and shows the FPD for the process. It quite important to uses inlet gas separator to remove any undesirable impurities such as, solid particulars and liquids. Amine contactor is also important part from the plant which it also need some specifications for example, streams temperature and pressure and the amine (DEA) concentration (35% by wt. is used) and figure (3) shows amine contactor menu. After finishing above steps amine heat exchanger is also installed. Moreover, dirty amine needs to be regenerate and that could be achieved by installing the amine regenerator after amine heat exchanger and figure (4) shows amine regenerator menu.

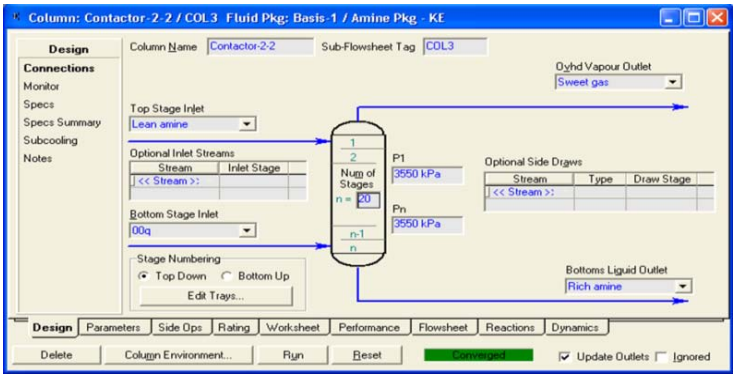

Figure 3 : Amine contactor menu

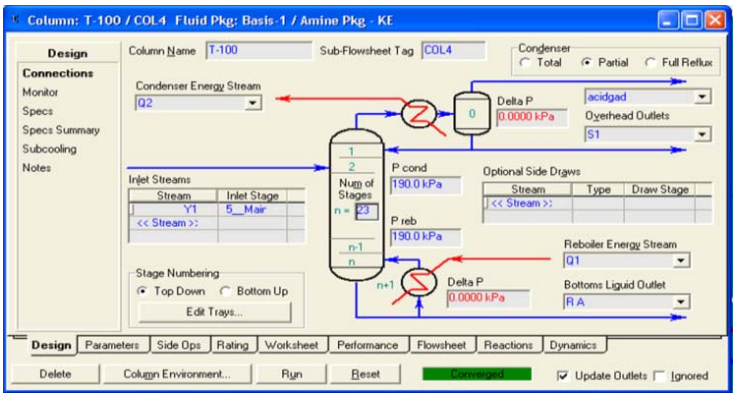

Figure 4 : Shows amine regenerator menu

The simulation process done successfully and figure (5) shows process flow diagram. As it seems from figure, (5) several processes unite are used in amine process. Infect, installing flash separator for rich amine is quite important in order to avoid any technical problems. Moreover, the ADJUST function is also important to adjust the mass flow rate of lean amine with the H2S molar friction in sweet gas stream. In addition, water make up stream should be added with a mixer to the process. In fact, amine concentration may be built up in the process because of water and amine losses with sweet gas. Therefore, water makes up stream will maintain and support the concentration of DEA at acceptable value. The simulation process done and the process achieved high acid gas removal that it will be discussed in result and discussion part.

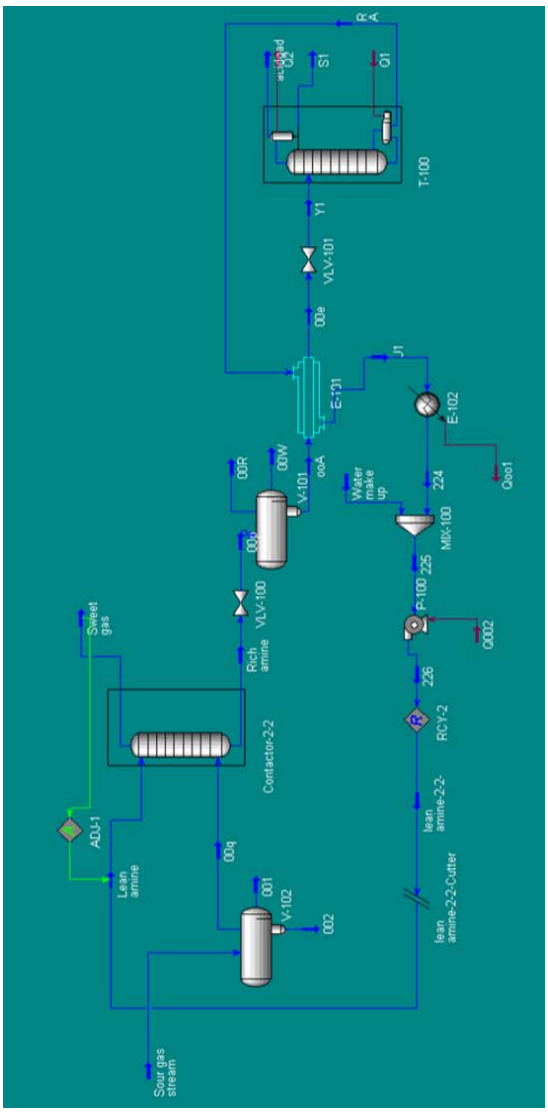

Figure 5 : Process flow diagram.

b) Effects of declining pressure on gas sweetening process

At the starting age of reservoir production, the reservoir pressure is usually sufficient to produce oil and gas as well. Moreover, it drives by natural reservoir mechanisms for example, water. Moreover, the wellhead pressure could be decreed or controlled by wellhead choke. As it showed that from given, gas stream data the reservoir peruse is high about 7000 Kpa. However, after period of reservoir production time the pressure will gradually declines. Thus, in this study part several operation pressure will be examined for example, 7000 Kpa, 6000Kpa,5000Kpa and 2000 Kpa. These values will be applied in previous HYSYS simulation program and the effects pressure change can be recognized for each case. Indeed, the declining of absorber pressure may lead to decrees the capacity of contactor unit. Figure (6) shows effect of declining operation pressure on natural gas capacity in amine sweetening unite.

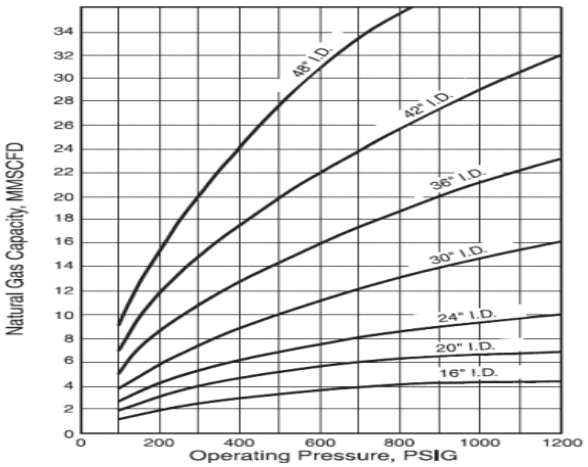

Figure 6 : Effect of declining operation pressure on natural gas capacity in amine sweetening unite (GPSA, 2004).

IV. Result And Discussion

Rich amine loading results for several assumed operation pressures are recognized and the whole results are transferred to MS excel program and the results can be showed in figure (7):

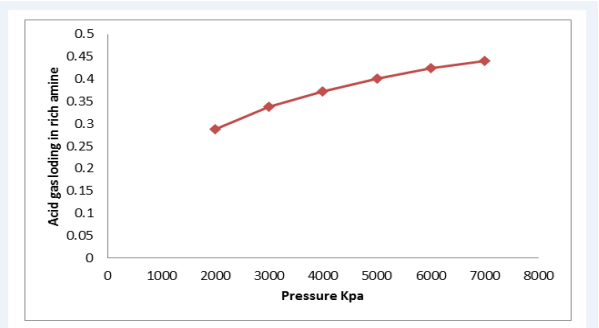

Figure 7 : Effect of declining pressure on DEA sweetening unit (20 plates in absorber).

It seems that from figure (7), the decreasing of amine contactor tower pressure due to declining of reservoir pressure has a direct effect on the rich amine lodging. As a result, the rich amine loading (moles of Acid gases/moles of amine) will be reduced and that will significantly effects the sweetening process performance. Moreover, in this case amine circulation rate should be increased in order to meet the product requirements and this will effect directly on process operation cost. Thus, drilling new wells or using EOR methods are the most economical and successful actions to overcome this problem. Thus, it can argue that if pressure of the amine contactor unite decreases due to decline in reservoir pressure then the partial pressure of Acid gases such as CO_2 will also be reduced.

V. Conclusion

In conclusion, this study is attempted to examine the effect of declining the reservoir pressure on gas sweetening process. Moreover, it is also simulated the gas sweetening process by Aspen HYSYS program. It can argue that the declining of reservoir pressure is directly affected amine gas sweetening process efficiency and performance and several technical problems for instance, it lead to increase the lean amine circulation rate, decrees rich amine acid gases lodging, increase in energy consumption by process and increase the operation cost. Moreover, it strongly recommended that incrusting the amine type or concentration in the process. However, this only could apply for short time because high amine concentration means high corrosion and cost. Therefore, the maintain of reservoir pressure by drilling additional well and using enhanced oil recovery method may consider the best solution to solve this problem.

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Biodiesel Production from Kapok Seed Oil (Ceiba Pentandra) Through the Transesterification Process by Using Cao as Catalyst

By Endah Mutiara Marhaeni Putri, M. Rachimoellah, Nidya Santoso & Ferdy Pradana

Institute Technology of Sepuluh November (ITS) - Surabaya, Indonesia

Abstract - The purpose of this research is to make biodiesel from Kapok Randu (name of kapok in Indonesia) seed oil (Ceiba pentandra), studied the effect of operating variables on the performance of the catalyst (CaO) in Kapok Randu oil transesterification process and knows the regeneration ability of the catalyst (CaO). In this research the variables used are the oil to methanol mole ratio 1:10, 1:15, and 1:20, the temperature of reaction is 40 ° C, 50 ° C and 60 ° C and the transesterification reaction time is 1 hour, 2 hours and 3 hours with CaO catalyst used is 7% of the mass of kapok oil.

From the research, the highest yield obtained in the variable mole ratio of 1:15 methanol, the reaction temperature of 60 C and the tra nsesterification reaction for 1 hour is 88.576%. In addition, CaO catalyst can be regenerated up to 3 times with the smallest yield obtained that is 64.3%.

Keywords : *Biodiesel, kapok seed oil, Ceiba pentandra, calcium oxide.*

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I. Introduction

Nowadays, Indonesia's oil reserves are running low, reaching 4 billion barrels, with a consumption of about 1 million barrels a day then Indonesia's oil reserve will be exhausted the next 13 years maximum. Therefore, the role of renewables and gas development should be increased. One of the alternative energy oil and gas interest is biodiesel. Biodiesel is a promising alternative fuel that can be derived from waste oil, animal fat or vegetable oil that has been converted into methyl esters through transesterification with alcohol.

Biodiesel gives less pollution than petroleum fuels and can be re-used without modification to diesel engines. Many materials can be used as a source of biodiesel feedstock,one of them is kapok seed. Kapok seed has the potential to be used as raw material for biodiesel because it has advantages such as containing 40% oil by weight, easy to obtain, and relatively cheap.

Transesterification is the most common method used to produce biodiesel. Transesterification is the reaction of plant oils (triglycerides) with alcohols using alkaline catalyst to produce biodiesel and glycerol. In the transesterification process, homogeneous alkaline catalysts that commonly used are NaOH, and KOH. One of the disadvantages in the use of homogeneous catalysts in the process of biodiesel production is the catalyst can not be re-used or can not be regenerated, because the catalyst is mixed with oil and methanol, and also the process of separating the catalyst from the product is more complex. The use of this homogeneous catalysts are also not environmental friendly because it requires a lot of water for the separation process, because of that, it is developed using solid catalysts in biodiesel production, such as CaO to overcome the lack of homogeneous catalysts.

II. Research Metodology

a) *Degumming Process*

Degumming is a separation process of impurities such as latex or oil-slime. Slime composed of phosphatides, proteins, residues, carbohydrates, water and resin, without reducing the amount of free fatty acids contained in the kapok oil because of the gum will cause the emulsion of soap and would interfere the oil refining process [1]. the oil degumming process using H_3PO_4 kapok 0.1% pa oil volume, the reaction for 30 minutes at a temperature of 70 ˚ C.

b) *Esterification Process*

Esterification of Free Fatty Acid (FFA) aims to eliminate the FFA in the raw oil. The FFA will be converted into biodiesel. If the FFA levels are too large, it can cause saponification reaction with the catalyst, therefore FFA levels should be kept up to 1% [2]. Esterification using 1% H_2SO_4 mass of oil pa, methanol pa 1:6 mole ratio with oil. Operating conditions: temperature 60˚C and reaction time 1.5 hours.

c) *Catalyst Calcination Process*

The calcination process is carried out before the the transesterification process. Because the CaO catalyst will be poisoned by CO_2 and convert into $CaCO_3$, thus reducing its activity as a catalyst. CO_2 is removed by calcination process on the $CaCO_3$ to produce a pure CaO. Calcination is performed at a temperature of 700˚C for 2 hours..

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d) Transesterification Process

Transesterification performed by inserting methanol into a three neck flask with a variable ratio of 1:10, 1:15, 1:20 mol ratio of methanol. Secondly, adding CaO catalyst as many as 7% of the mass of the inlet oil. After a homogeneous mixture, kapok oil is inserted into a three neck flask and heated at a variable temperature 40,50,60°C in 1,2,3 hours of stirring. After the reaction, CaO catalyst is screened by using a filter paper (0.7 μm) and then we separate the FAME formed with glycerol using a glass funnel separator.

e) Analysis

Analysis conducted are the analysis of FFA content in the oil using titrimetric methods, analysis of biodiesel density, analysis of viscosity biodiesel using Ostwaldz viscometer, and GCMS analysis to view the content of the biodiesel produced

III. Results and Discussion

a) Effect Of The FFA Content On Oil

Based on the analysis of FFA levels in kapok oil that used as raw material for the biodiesel production, oil content of FFA obtained is 9.317%. FFA value exceeds the maximum amount of FFA content to do the process of transesterification, which is a maximum of 1%. Therefore esterification process should be carried out.

Levels of FFA in the oil feedstock should be measured every period of time due to increased levels of FFA in the oil along with storage time. Factors that affect the speed increased levels of FFA in oil feedstock include temperature and humidity, therefore it is important to put the oil on the conditions of low humidity and low temperatures to prevent growth of FFA that resulting decreased efficiency and yield process.[3].

b) Density Analysis Results

The density is the weight per unit volume ratio. These characteristics related with calor value and the power generated by diesel engines per unit volume of fuel. If biodiesel has a density exceeding the provisions, the incomplete reaction will occur at the conversion of vegetable oil. Biodiesel that below the quality, should not be used for diesel engines because of will increase emissions, and cause damage to the machine [4].

From the analysis of all variable, according to the results obtained with the standard biodiesel according to SNI 04-7182-2006, which is the density still in the range 0.850 to 0.890 g/cm^3.

c) Viscosity Analysis Results

Yield of biodiesel or Fatty Acid Methyl Ester (FAME) produced can also be estimated through the viscosity of biodiesel rates. Conversion of triglycerides into methyl esters through the transesterification process resulting a reduce on molecular weight of triglycerides and reduce its viscosity. Viscosity is one of important parameter in the feasibility of using biodiesel in diesel engines [5].

Viscosity is the resistance of the fluid held in a capillary tube againts the force of gravity which is usually expressed in the time required to flow at a certain distance. If the viscosity is higher, the higher resistance will be. It is very important because it affects the performance of injectors in diesel engines. Fuel atomization is also very dependent on the viscosity, higher viscosity makes atomized fuel into larger droplets with high momentum and have a tendency to collide with the cylinder wall relatively cool. This leads to an increase in deposits and fuel emissions. Instead with low-viscosity fuel will produce a very subtle spray and can not get into the combustion cylinder thus forming the fuel rich zone which led to the formation of soot. Viscosity also related to the viscosity lubrication or lubrication properties of fuel. Relatively high viscosity has better lubrication properties [4].

From the analysis viscosity on the whole variable from the transesterification process the results obtained with the standard biodiesel according to SNI 04-7182-2006, is still in the range 2.3 – 6 Cst.

d) GCMS Analysis Results

Table 1 : Library data of 3 best hits, GCMS analysis on Peak Number : 3, time : 16,72 minute, Area : 3197204978, %Area : 22,3 %

No	Content	Qual
1	Hexadecanoic acid, methyl ester	99
2	Hexadecanoic acid, methyl ester	98
3	Hexadecanoic acid, methyl ester	98

Table 2 : Library data of 3 best hits, GCMS analysis on Peak Number : 8, time : 18,70 minute, Area : 10213727390, %Area : 70,71 %.

No	Content	Qual
1	10,13-Octadecadienoic acid, methyl ester	96
2	9,12-Octadecadienoic acid (Z,Z)-, methyl ester	96
3	9,12-Octadecadienoic acid (Z,Z)-, methyl ester	96

Table 3 : Library data of 3 best hits, GCMS analysis on Peak Number : 9, time : 18,82 minute, Area : 485394187, %Area : 3,36 %.

No	Content	Qual
1	Octadecanoic acid, methyl ester	99
2	Octadecanoic acid, methyl ester	99
3	Octadecanoic acid, methyl ester	98

From the GCMS Analysis gained the content of methyl ester with % *Area* as 22,3 % (Hexadecanoic acid / Methyl Palmitic), 70,71%, and 3,36% (Octadecanoic acid / Methyl Stearic). We can conclude that Kapok seed oil can be used as a raw material for biodiesel production.

e) Effect of temperature on biodiesel yield

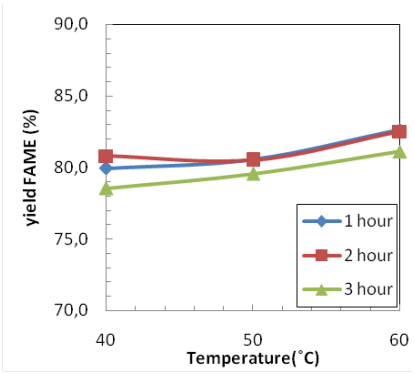

Figure 1 : The effect of temperature on biodiesel yield charts in kapok oil transesterification reaction at a ratio of oil: methanol = 1:10 mol ratio.

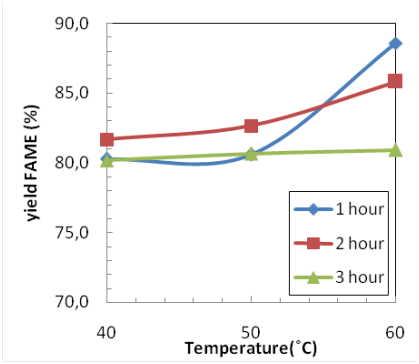

Figure 2 : The effect of temperature on biodiesel yield charts in kapok oil transesterification reaction at a ratio of oil: methanol = 1:15 mol ratio.

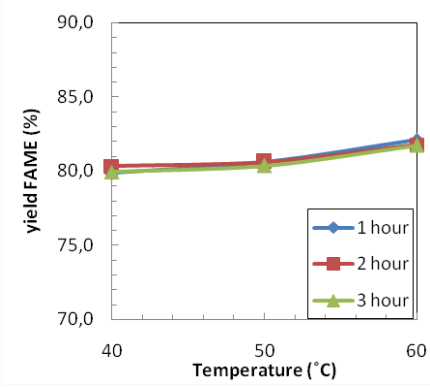

Figure 3 : The effect of temperature on biodiesel yield charts in kapok oil transesterification reaction at a ratio of oil: methanol = 1:20 mol ratio.

The usage of heterogeneous catalysts will make the reaction mixture consisting of three-phase system, oil-methanol-catalyst, where the reaction is slowed down due to the diffusion resistance between the phases. However, the reaction rate can be accelerated at higher temperatures [6]. Effect of temperature on reaction rate can be explained through the theory of chemical reaction kinetics. An increase in temperature will result in increasing fraction of molecules that have a high speed and therefore has a high kinetic rate [7]. Effect of temperature on the transesterification reaction of kapok oil is examined at 40, 50, 60 ˚C, in the reaction conditions, oil: methanol, 1:10, 1:15, 1:20 mole ratio and reaction time 1, 2, 3 hours. As shown in figure 1,2,3 reaction rate was slow at low temperatures and increases with increasing temperature, in accordance with the laws of kinetics reactiom. Optimum yield of biodiesel obtained at a temperature of 60 ˚C at all the variables in this experiment.

f) Effect of time reaction on biodiesel yield

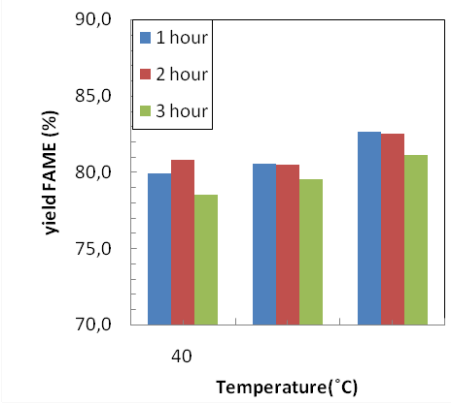

Figure 4 : The effect of reaction time on biodiesel yield charts in kapok oil transesterification reaction at a ratio of oil: methanol = 1:10 mol ratio.

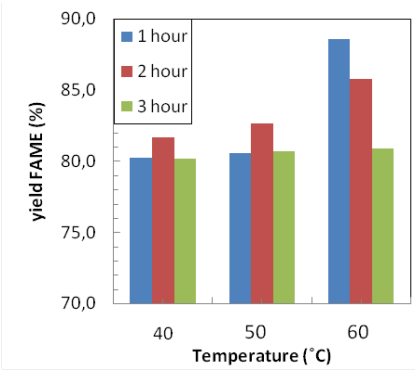

Figure 5 : The effect of reaction time on biodiesel yield charts in kapok oil transesterification reaction at a ratio of oil: methanol = 1:15 mol ratio.

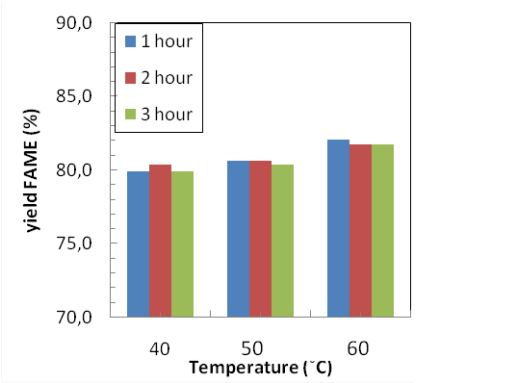

Figure 6 : The effect of reaction time on biodiesel yield charts in kapok oil transesterification reaction at a ratio of oil: methanol = 1:20 mol ratio.

The reaction time will be directly proportional to the percent yield of biodiesel obtained. The rate of conversion increases with the length of reaction time. Diglycerides and monoglycerides at the beginning of the reaction time, will increases and then decreases. In the end, the amount of monoglycerides will be higher than diglycerides. And monoglycerides required for the transesterification reaction [8]. From figure 4,5,6 the effect of reaction time on biodiesel yield produced can be seen. Optimum biodiesel yield obtained on a variable ratio oil: methanol = 1:15 mol ratio, temperature of 60 ◦ C, and reaction time 1 hour, the resulting yield of 88.576%. While the increase in reaction time at 3 hour reaction time, have lowered the yield obtained in all variables, it because CaO catalyst can adsorb the product [9]. CaO catalyst has a tendency to absorb products when the reactants in a lack, thereby it reduce the activity of the catalyst due to the active surface of the catalyst is covered by the absorbed products (monoglycerides, diglycerides, triglycerides, and glycerol) that resulting yield decrease [2].

g) Effect of mol ratio on biodiesel yield

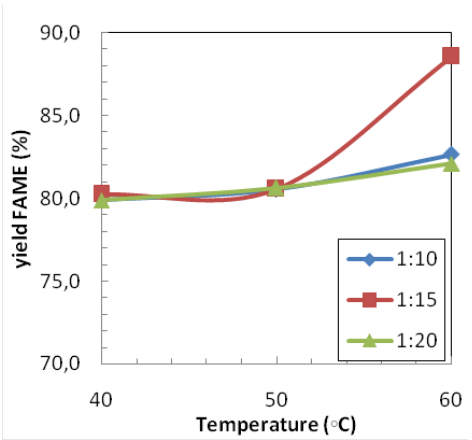

Figure 7 : The effect of mol ratio on biodiesel yield charts in kapok oil transesterification reaction at a ratio of oil: methanol = 1:10 mol ratio.

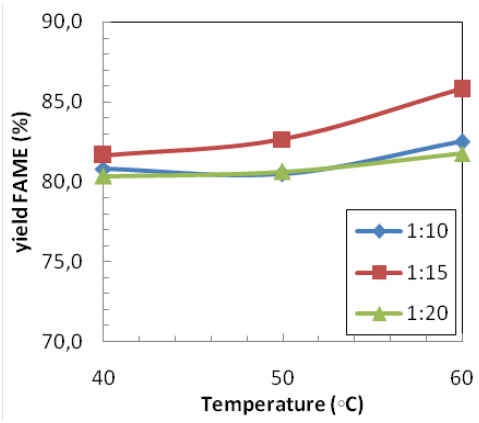

Figure 8 : The effect of mol ratio on biodiesel yield charts in kapok oil transesterification reaction at a ratio of oil: methanol = 1:15 mol ratio.

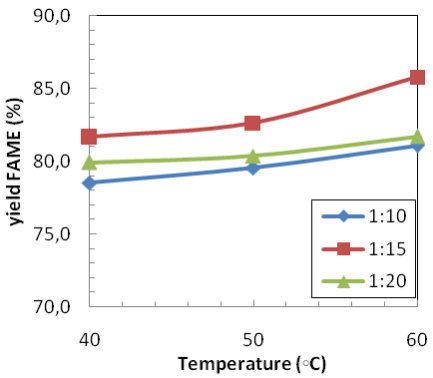

Figure 9 : The effect of mol ratio on biodiesel yield charts in kapok oil transesterification reaction at a ratio of oil: methanol = 1:20 mol ratio.

In stoichiometry, one mole of triglycerides requires three moles of methanol in the transesterification reaction to produce methyl esters (biodiesel). Transesterification is reversible reaction, that the excess methanol is made to run the reaction toward the formation of methyl esters (biodiesel). From the figure 7,8,9 can be seen that the yield increased with increasing molar ratio. As a comparison, biodiesel yield increased from 80.5% to 82.648% (variable 50 ◦ C, time 1 hour) when mole ratio increased from 1:10 to 1:15. But the yield decreased when the mole ratio increased to 1:20 (80.621%). This happens because the catalyst has decreased due to higher content of methanol [6]. Therefore, the optimum mole ratio of oil: methanol for these experiments was 1:15.

h) CaO Catalyst Regeneration

In order to examine the regeneration of the catalyst CaO, CaO catalyst is separated from the reaction mixture using filter paper size of 0.7 µm. After that the catalyst was washed with methanol and dried in an oven at 100 ˚ C for 1 hour [9]. Before the transesterification process, the catalyst recalcined back

at a temperature of 700 ° C for 2 hours. Transesterification process performed on variable ratio oil: methanol = 1: 10 mole ratio, at 60 °C and a reaction time of 1 hour.

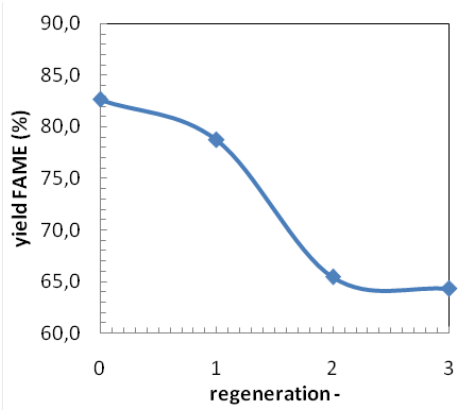

Figure 10 : CaO Catalyst Regeneration Charts.

The results obtained in Figure 10 show that the CaO catalyst can regenerated for 3 times, after being used as much as 3 times the yield of biodiesel have declined by 64.3%, so it is not continue to regenerate again.

IV. Conclusion

From this research several conclusions can be made:

1. Based on the results of GCMS analysis can be seen that the kapok seed oil can be used as raw material for biodiesel.
2. The highest levels of FAME produced under conditions of oil to methanol mole ratio 1:15, reaction temperature 60 ° C, and reaction time of 1 hour, amounting to 88.576%.
3. CaO catalyst can be regenerate back 3 times with the smallest yield obtained in the amount of 64.300%.

V. Acknowledgments

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Municipal Solid Waste Management (Msw) Scenario in Kurnool City, Andhra Pradesh, India

By T.Ramachar, K.Mohammed Rafi, M.Umamahesh & N.V.S.Guptha
R.G.M.Engg.College(Autonomous), Nandyal

Abstract - Municipal Solid Waste (MSW) is defined to include refuse from households, waste from commercial establishments, and refuse from institutions, market waste, yard waste and street sweeping (World Bank 1994). Waste is an unavoidable by-product of human activities, economic development, urbanization and improving living standards in cities. The increase in quantity and complexity of waste generated in municipalities and notified areas have become serious concern for Government departments, pollution control agencies, regulatory bodies and also the public in India. Inefficient management, utilisation and disposal of this solid waste is an obvious cause for the degradation of environment in India. Improper disposal of this waste generated leads to spread of communicable diseases, causes obnoxious conditions, pollutes all vital components of living environment (air, water & soil) and spoils the bio sphere as a whole. Cleanliness is a major factor that influences development of any nation, which otherwise hampers due to improper disposal of solid waste. Urban society rejects and generates solid materials regularly due to rapid increase in production and consumption.

Keywords : *Municipal Solid Waste (MSW), Municipal Solid Waste Management (MSWM), composting, vermin composting, landfill site, Kurnool Municipal Corporation (KMC), Ministry of Environment and Forest (MoEF).*

GJRE-C Classification : *FOR Code: 869804p*

Strictly as per the compliance and regulations of:

Municipal Solid Waste Management (Msw) Scenario in Kurnool City, Andhra Pradesh, India

*T.Ramachar [α], K.Mohammed Rafi [σ], M.Umamahesh [ρ] & N.V.S.Guptha [ω]

Abstract - Municipal Solid Waste (MSW) is defined to include refuse from households, waste from commercial establishments, and refuse from institutions, market waste, yard waste and street sweeping (World Bank 1994). Waste is an unavoidable by-product of human activities, economic development, urbanization and improving living standards in cities. The increase in quantity and complexity of waste generated in municipalities and notified areas have become serious concern for Government departments, pollution control agencies, regulatory bodies and also the public in India. Inefficient management, utilisation and disposal of this solid waste is an obvious cause for the degradation of environment in India. Improper disposal of this waste generated leads to spread of communicable diseases, causes obnoxious conditions, pollutes all vital components of living environment (air, water & soil) and spoils the bio sphere as a whole. Cleanliness is a major factor that influences development of any nation, which otherwise hampers due to improper disposal of solid waste. Urban society rejects and generates solid materials regularly due to rapid increase in production and consumption. The objectives of Municipal Solid Waste Management (MSWM) are to control collect, process, utilise and dispose of solid waste in the most economical way consistent with the protection of public health and the natural environment. Kurnool is one of the largest developing cities in Andhra Pradesh (India) and is undergoing rapid expansion and modernization. This paper presents a case study of present situation of MSW in Kurnool and the process being implemented presently. An environmental audit of MSWM in Kurnool city was under taken to understand the shortcomings including some possible proposals.

Keywords : Municipal Solid Waste (MSW), Municipal Solid Waste Management (MSWM), composting, vermin composting, landfill site, Kurnool Municipal Corporation (KMC), Ministry of Environment and Forest (MoEF).

I. Introduction

The solid waste generation is an index of socio-economic development and economic prosperity of the region. Increasing industrialisation and raising income lead to greater use of resources and waste composition is influenced by the factors such as extent of urbanisation, standard of living and climate. Thus waste quantities as well as composition are inextricably linked to the vibrancy of economic activity and resource consumption. MSWM in India is regulated by MSW(Management & Handling) Rule 2000 (1). In Kurnool a decade ago per capita generation of waste was 0.4 kg/day now it is 0.7 kg/day.

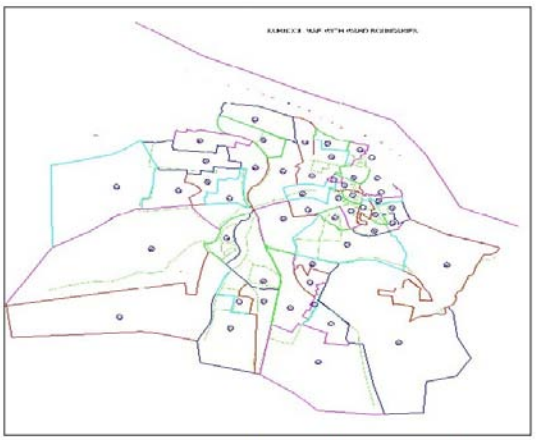

Figure 1. Kurnool City Ward wise Map

Kurnool is one of the fastest developing cities in Andhra Pradesh with a population of 4 lack 60 thousand in 2011 in urban agglomeration, registering a growth of 20% over the past decade. The city has around 1 lack 60 thousand houses which generate 330 metric tons of solid waste per day. Kurnool is the head quarters of the district of the same name and is situated between a latitude of 15-48" and 78 east longitude of the Secunderabad – Dhronachalam section of South central railway at a distance of 210 km south of Secunderabad. It is developed as a transit place on the southern banks of the river Tungabhadra and was commonly known as ' Kandenavolu'. It was a greasing place for the carts which were used to transport stone for the construction of a temple at Alumpur from which the name 'Kandenavolu' was derived. After independence the national government took over the administration. After separation of the 11 districts of Andhra Pradesh from the composite Madras state in 1953. Kurnool became the state Head quarters on October 1, 1953. The Telugu speaking areas of erstwhile Hyderabad state were merged with Andhra Pradesh and the Andhra pradesh state came into existence in November 1956 and state capital was shifted from Kurnool to Hyderabad. Kurnool

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has remained the district Head quarters. The historic Konda Reddy Fort is located in the heart of Kurnool. It has a literacy rate of 63% and average rain fall 70cc per annum.

The Kurnool city has an area of 49.75 sq.km and is divided into 50 wards. The city has 253.72km c.c.Roads, 82.76km B.T Roads, 95.77km KWBM Roads and 253.72km Kutch Roads. The city has 546.751km c.c. Drain and 382.93km Kutcha Drains. The MSW generated is managed by KMC which was upgraded as carporation on August, 1994

II. Population Growth

In 1981 the population of Kurnool was 2, 06,362, in 1991 it was 2, 33,717 by 2001 it became 3, 42,973 now the population has reached 4, 60,000. (Not officially declared by central Government). The following graph indicates the population growth. An increase of 15% is noticed in 1991 from then the population has doubled in next two decades.

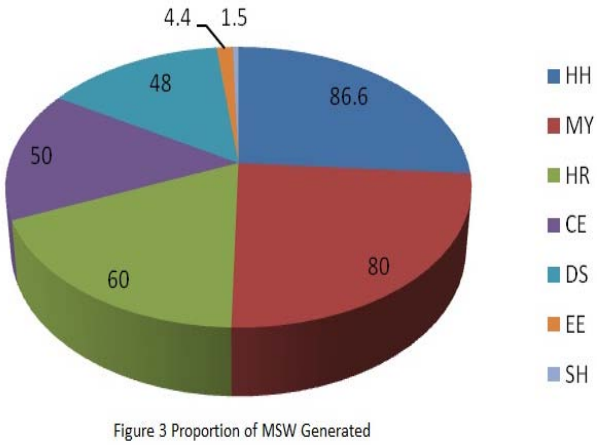

Figure 3 Proportion of MSW Generated

Figure 2 : Population Growth.

Table 1 : Sources of MSW.

S No.	Source	Number
1	Houses	1 lack 60 thousand
2	Hotels	51
3	Function Halls	42
4	Vegetable markets	5
5	Meat & Chicken markets	1
6	Fish market	1
7	Slaughter house	6
8	Hospitals*	65
(*Hospital waste is not handled by the KMC)		

III. Sources of Msw

Table-1 presents the sources from which MSW gets generated.

IV. Break up of Msw

Proportion of MSW generated is presented in the Table-2

Table 2 : Proportion of MSW Generated.

S.No.	Generation point	Quantity per day MT
1	Households (HH)	86.6
2	Market yard (MY)	80
3	Hotels & Restaurants (HR)	60
4	Commercial Establishments (CE)	50
5	Drain silt & debris (DS)	48
6	Education establishments (EE)	4.4
7	Slaughter Houses (SH)	1.5
Total garbage generated		330.5

Out of 330.5 MT of MSW 30% is house hold waste, 15 – 20% of the MSW generated remains uncollected. Projected quantities of MSW is presented in Table-3

Table 3 : Projected quantity of waste.

S No.	Year	Quantity Generated per anum in MT
1	2010	97200
2	2011	119004
3	2012	126000
4	2013	136800
5	2014	151200
6	2015	172800

The projection estimates indicates that the quantity of MSW generated will be doubled in the next five years.

V. Methods

a) Collection of MSW

i. *Community Dust Bins*

Solid waste obtained from commercial establishments, house hold, by road sweeping, drainage silt is being dumped into the community dust bins dumper placer which are of concrete or metal dust bins. From the dust bins the garbage is loaded into dumper trucks /Lorries. Figure-4

Figure 4 : The dumper placer.

ii. *Door-to door collection*

KMC introduced voluntary garbage collection by providing tricycle. A tricycle puller collects garbage from

150 houses by collecting Rs20/ from each house. After collection the tricycle puller dumps the collected garbage in to the nearby community dust bin. This practice is being implemented by KMC in 7 wards for the last six months on trial basis.

Figure 5 : Door-to Door collections.

iii. *Road Sweeping*

According to the Supreme Court guidelines 2000, an efficient sweeping can support a better SWM, because one of the main problems is garbage on the roads. KMC has tried to achieve a better SWM via an efficient sweeping. The 762 strong conservancy workers consisting of the corporation staff and the private contractors sweep the city based on the formations called units (day & night) innovated by the KMC. There are some units that sweep in the day and the others that sweep in the night. Night sweeping is done to prevent people from exposure to the dust. Of the total sweeping staff, 391 are the corporation employees, and the rest are the employees of the private contractors who work under the control of KMC, KMC is engaging private workers for sweeping the roads. The waste collected is dumped in the nearby dust bins. Many times the garbage is being burnt or dumped in the road side drains. The drains get choked resulting in the overflow during rains. The placing of dustbins on the roads and streets is based on the people's choice. Wherever they have been throwing the waste, that place is given a dustbin and it becomes a collection point. The collection system is spread across the city.

Figure 6 : Road sweeping.

b) Tranportation

Previously, carters were paid by individuals to carry trash and discard it on the outskirts of town. Disposal in open pits became routine and first municipal cleaning program was initiated in Philadelphia in 1757. Since then we have developed types of waste that cannot simply be dumped into a hole. Transportation means conveyance of MSW from place to place hygienically through specially designed transport system so as to prevent foul odour, littering, unsightly conditions and accessibility to vectors. The following Table-4 presents the details of transporting MSW.

Table 4 : Details of transportation of MSW.

S.No.	Type of vehicles	Number of vehicles	Capacity MT	Trips per day	Total amount of MSW MT
1	Tippers	5	4	2	8
2	Tipper trucks	5	2	8	16
3	Dumper placer	5	3	24	72
4	Tractors	17	2	6	174
5	3-wheller auto tippers	6	0.5	18	9

Figure 7 : MSW transportation.

The garbage is being transported to the dumping site Gargeyapuram which has 61.7 acres of dumping area located 18 km from the city. Table-5 presents the human resource engaged in collection, transportation, processing on MSW(2).

Table 5 : Human resources in MSWM.

S.No.	Post	Strength
1	Health officer	1
2	Environmental engineer	1
3	Senior Entomologist	1
4	Sanitary supervisors	1
5	Sanitary Inspectors	7
6	Malaria sanitary inspectors	1
7	Health Assistants	4
8	P.H.Drivers	9
9	P.H.Maistries	16
10	Public Health Workers*	792
11	Malaria Mazdoors	23
12	Public Health Cleaners	2

**Includes 391 KMC health workers.*

c) Processing MSW

At present KMC is not processing the waste collected. The MSW without segregation is being dumped in the dumping site Gargeyapuram dumping yard located 18 km from Kurnool. At the dumping site there is one JCB Proclainer is operating .

d) Procedure Followed to Get Composition of MSW

The house hold garbage collected by the tricycle puller from 100 houses (consisting of slum, middle income group & high income group) is segregated and quantity of segregated waste is noted, this procedure is repeated for four days in a weak on different days. The average value is noted. The samples are collected from commercial areas, hotels, parks and street sweepings (from selected localities). Samples are also collected from the duping sites. The samples were segregated and weighed. The results are presented in the Table-7. The average composition of MSW is shown in the last column.

Figure 8 : Weighing after segregation.

Table 7 : Composition of MSW.

Category of waste	House hold	Market	Hotels	Commercial areas	Street sweeping	At the dumping site	Average composition of MSW
Food waste/Vegetable/fruits (Fermentable)	70.7	91	90	10	13	20.5	49.6
Plastic/Rexene	8.6	2	4.5	37	40	9	17.5
Paper/Cardboard	6.7	2	1.5	25	12	10	9.7
Cloths/Jute	1.5	0.2	-	10	5	12	4.7
Stones/Rubbles	-	-	-	4	14	14	5.3
Dirt &Fine particle	5.8	5	2	9	12	21	8.6
Metals &Glass	0.2	-	0.5	5	3	4	2.2
Bones	0.1	-	1.5	-	-	1.5	0.5
Coconut	7	0.6	-	0.9	-	3.5	0.8

The survey revealed that the average generation of waste ranges from 0.5 kg/capita/day to 0.7 kg/capita/day.

VI. Results and Discussions

The techniques and the shortcomings of the techniques adopted for handling of MSW have been identified. Door-to-door collection is adopted in 7 wards on trial basis, which has resulted in efficient collection of waste and reduction of littering, foul odour and anaesthetic appearance of bins. However, in commercial areas, due to the absence of community bins, waste generated is disposed in the street. A few waste heaps can be found on the roadsides in commercial areas. All the trucks that are used for transportation of waste have no polythene covers/meshes and this results in littering, scattering of waste and foul odour during transport. The entire MSW is disposed off in the Gargeyapuram dump yard, causing foul odour, scattering, leachate formation, and air pollution from burning and methane emission from decomposing organic matter.

a) Storage

The household waste is stored in the dust bins and from there it is being transferred into the community bins. Many a time the household is not transferred into the bins it is scattered around the bin or it is littered in the vacant space. The public must be educated to collect all the wet waste & dry waste separately. The same must be handover to the tricycle collection boy.

b) Collection

i. *Source Collection*

Adopting the door-to-door collection method in some wards has proved to have many advantages. The complaints from residents due to anaesthetic bins near their houses have stopped, the number of stray dogs and stray cattle has reduced and the no bin system has also improved the waste handling by people or residents. This method is also better suited for collection of segregated waste. Suryapet (Nalgonda district A.P) secured the ISO 14001-2004 certificate dust bin free town (4). Door-to-door collection must be introduced in all the areas. The tricycle must be provided with two compartments, one for wet waste & for dry waste. After collecting the waste the tricycle puller must transfer the same separately this is very convenient for processing of MSW. During door-to-door collection the pourakarmika (tricycle puller) manually segregates the waste. It is very important that this is carried out with proper protection. The staff should be provided with

gloves, footwear, apron, masks and goggles for safety, as they are constantly exposed to waste every day. The waste collected in community dust bins must be transported to the dumping yard. The available community bins are not adequate; some are to the dilapidated condition. Because of this the garbage is being dumped on the roads. The metal dust bins must be painted to prevent rusting and prolong its life. Small litter bins should be provided for the pedestrians in commercial areas. There is a lack of community bins in a few of the commercial areas. Due to the high generation of waste in commercial areas, the waste is not always stored on site, but is disposed on the roadsides, causing anaesthetic appearances. Well-designed community bins have to be placed in commercial areas, depending on the quantity of waste generated. The maintenance of the present bins is poor and has resulted in rusted bins having sharp edges. This can prove to be dangerous to the collection staff and also to the users. The staff must be provided with well fitting gloves for safety. Community bins should be provided with a partition for separate collection of waste and proper colouring and labelling on the bins. To improve the separation of waste at source and throughout the MSWM process, adequate staffing, supervision, procedures, training, posters, verbal reminders, reporting, meetings and equipments are required.

ii. *Sweeping*

The MSW collected from sweeping of the roads is transferred into the nearby bin. During the survey it is noticed waste is being pushed into the drains which results in blocking of drains. The sweepers must be educated on the effects of blocked drains; regular inspection of drains must be made.

iii. *Rag Pickers*

The rag pickers collect recyclable waste on the roads. The recyclable waste is collected by the rag pickers sell to the recyclable waste traders, from where it is transported to the recycling factories. The decrease in the percentage of plastic at the dumping site (from table -7) is because of rag pickers. At present from the Kurnool city 20 tons of plastic and 7.8 tons of waste iron is being transported daily.

Figure 9 : Recyclable waste collected by rag pickers.

VII. Transportation

At present KMC is transporting the garbage collected by means of dumper trucks, dumper tractors, dumper placers. However, there is no proper enclosure provided to prevent the wet waste from leaking on to the road. It is very essential that all trucks have mesh and polythene covering (3) with a proper enclosure to prevent scattering of waste, foul odour and leakage while travelling on crowded roads. The waste is not segregated at an intermediate level and is directly transported to the disposal site. Long distance from ward to dump site, hence less number of trip a day is made by each truck. Transfer stations to be provided where waste can be further segregated and higher efficiency for transportation can be achieved by increasing the number of trips made by each truck.

VIII. Processing

Any municipal solid waste generated in a city or a town, shall be managed and handled in accordance with the compliance criteria and the procedure laid down in Schedule-II (2). In the current MSWM system presently adopted in KMC can cause irreversible damage to the surrounding areas and is extremely hazardous to the environment. The MSW is being dumped in the dumping yard. This will cause foul odour, flies and bird menace. The waste is burnt which emits toxic gases and causes air pollution. It is suggested to provide composting and vermin composting units which not only produce biogas but also produce fertiliser. Waste to energy plants like production of refuse derived fuels and incineration plants can be set up to use waste from commercial areas once the source segregation process is set in place which not only reduce the volume of waste for land filling but also produce heat which can be used to generate steam for producing electrical power.. Suryapet (Nalgonda district A.P) won excellent award and won the Supreme Court's appreciation for proper solid waste management (5).

Some important factors that need to be considered for the overall improvement of the waste management system are:

- *Monitoring*. By monitoring the efficiency of collection, transportation, process, disposal, the number trucks and trips made by trucks to the specified disposal site. This should become an integral part of the waste management system. The municipal authority not only has to monitor their own staff's activities but also the activities carried out by the private organisations. The State pollution control board has to carry out regular inspections of the dump yards
- *Training and education*. Environmental education is a way of increasing. Understanding of problems, cooperation among stakeholders, environmental Entrepreneurship and environmental performance.

The training should be a regular feature of MSWM, with hands on training on sorting and collection. After training there should be follow up of the practices.

- *Health and safety programmes*. It has been a common observation that in Kurnool maintenance staffs do not use the protection. Regular health and safety programmes are required to educate the staff on the ill effects of manual handling of waste, walking bare foot in dump yards and continuous exposure to waste. Regular health checkups should be carried out to monitor the health of the workers.
- *Involvement of the community*. Community involvement in waste management monitoring programmes like that of Suchi Mitra should be encouraged and more people should be involved in such activities. This increases the environmental awareness of the participants and other people. This is one of the fastest and most effective ways to make the public understand the importance of activities like sorting.
- *Integration of waste pickers*. NGOs should organise waste pickers, and, instead of the waste pickers retrieving waste at the dump yard which is extremely hazardous to their health, safer methods of retrieving waste from the source by the waste pickers should be developed. In this regard Gamana a voluntary organisation with the support of KMC is conducting awareness programs to the public and educating the cycle pullers regarding segregation of waste into wet & dry waste. Additionally, the waste pickers should be paid to retrieve waste from process plants and dump yards, instead of them paying to access the waste. Ways of improving the working conditions of the waste pickers and providing safety gear for them should be developed.
- *Planning*. The waste management that is carried out currently comprises more low cost measures in order to comply with regulation and avoid public agitation and complaints. There is no environmental management planning that is taken into consideration. A more systematic and proactive approach to management is required when the complexity of the programme increases. This would help to ensure that requirements are handled in a consistent and professional way and problems are addressed promptly and effectively. This would also ensure that the staff has clear objectives and goals while carrying out their activities.
- *Public participation*. Currently the main hindrance to the implementation of the MSWM is due to lack of public participation. It is very essential to educate the public regarding segregation of wet & dry waste separately before any project is implemented, a public participation meeting be held to make the public aware of impacts of mixed waste dumping and the problems associated with..

Reasons for non-compliences in waste collection are .

1. Lack of public awareness, motivation and education.
2. Lack of publicity through electronic and printing media.
3. Lack of financiers to create awareness.
4. Residents to change/negligence/reluctant personal in ULB.
5. Difficulty in educating slum dwellers.
6. Lack of sufficient knowledge on benefits of segregation.
7. Non-cooperation from household, trade and consumers.
8. Unwillingness on part of the citizens to spend on separate bins for recycling.
9. Lack of adequate litter bins in the city.
10. Lack of powers to collect spot fines.
11. Lack of financial resources for procurement of tools and modern vehicles.

Constraints for increasing treatment and disposal facility are

1. Lack of support from the state Government.
2. Non-availability of appropriate land.
3. Lack of knowledge and skilled manpower for treatment and disposal of waste.
4. Delay in clearance of disposal site.

Drawbacks in present MSW services

1. Absence of community participation.
2. No sort age of waste at source.
3. Apathy of Municipal Authorities.
4. No system of primary collection from the door step.
5. Open storage depots causing spillage and necessitating multiple handling.
6. Open, multiple and faulty transportation of waste.
7. Unscientific disposal of waste.

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Detection of Microstrcture of Roughness by Optical Method

By R.Daira & V.Chalvedin

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Abstract - Problem stastement : The digital holography technique, used in measuring the deformations of the scatterers, the process is based on subtraction of interference patterns. A first image is recorded before the deformation of the object in the RAM of a computer, a second followed after deformation. The square of the difference between the two images provides correlation fringes in real time directly observable on the monitor.

Results : The interpretation of these fringes to determine the deformation.

Conclusion : In this paper, we present experimental results of the variation of diffraction patterns for various displacements of paper.

Motsclés : Non destructive control, Aluminium, Interferometry, treatment of image.

GJRE-C Classification : FOR Code: 090406, 090499

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Detection of Microstrcture of Roughness by Optical Method

R.Daira [α] & V.Chalvedin [σ]

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Results : The interpretation of these fringes to determine the deformation.

Conclusion : In this paper, we present experimental results of the variation of diffraction patterns for various displacements of paper.

Motsclés : Non destructive control, Aluminium, Interferometry, treatment of image.

I. Materials and Method :

The setup used for this purpose is very simple and is as follows:

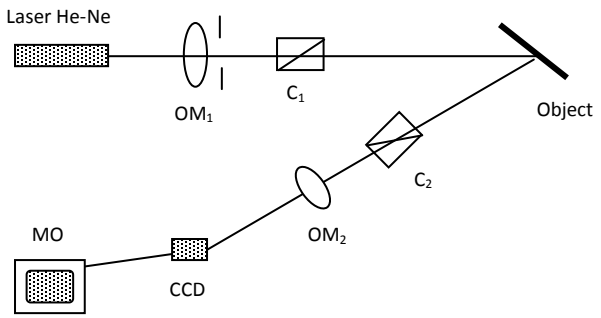

Figure 1 : Descriptif schema of optical assembly.

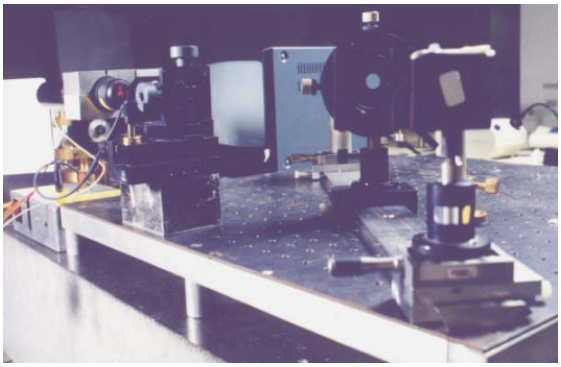

Figure 2 : Real schema.

A He-Ne laser illuminates the object through a microscope objective to expand the beam. An optical system (lens) creates an image of this object. A CCD camera connected to a "frame grabber", connected to a PC, save the image. The computer allows us to calculate the sum of the images and then calculate and display the Fourier transform of this sum. The objects used in this operation are pieces of sandpaper of different granularities. The optical system used in our installation is a simple lens of focal length f = 14 cm. For reasons of ease of handling, we took a magnification of 1. Therefore, as [1, 2, 3]:

$$\frac{1}{f}=\frac{1}{p}+\frac{1}{q} \quad \text{et} \quad M=\frac{q}{p}$$

There are :

$$q = M.p = p$$

$$\frac{1}{f}=\frac{2}{p}$$

$$q = 2f \qquad (1)$$

Moreover, in order to vary the size of speckle grains, we have arranged a diaphragm (a pupil, ie a circular aperture) we can easily vary the diameter. This diaphragm is placed right up against the lens so that the system can be likened to a lens of variable diameter. Then we compute the Fourier transform of this sum, as explained in the theory, gives us a background radiation modulated by a term in cos ^{2}, in fringes.

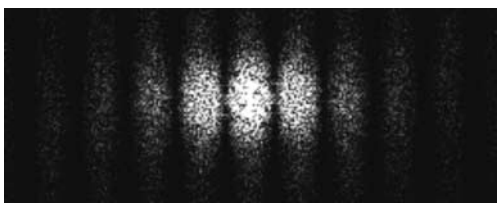

Figure 3 : The Fourier transform of the diffraction pattern.

Then we start all over for an equivalent movement of the camera (remember that a moving object D micron is equivalent to a displacement of the camera MD microns). Finally, we compare the results obtained in both cases. To make this comparison, we realize the profile of the fringes.

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In this graph, a maximum contrast (thus equal to one) is seen when the fringe back down each time down to zero. A loss of contrast will show up in fringes less marked, that is to say that the maxima and minima are vertically closer. But the loss of contrast is seen directly by elevated minima of this curve. So it is with this profile that we will quantify the loss of fringe contrast.

As mentioned in the introduction to this manipulation, we are interested in the loss of contrast as a function of surface roughness scattering. Initially, we used abrasive papers of different grain sizes and different luminous backgrounds.

But it appeared that this colored background has some significance. One can convince of it by looking at the profile below. These were obtained for papers of the same granularity but one had a yellow background, the other a brown background.

We see that the fringes are more distinct for the brown paper for paper yellow. This difference is marked especially at the edges of the profile. For the yellow paper, the modulation is visible only by the central peak. We then thought about taking sandpaper identical colors. But we quickly realized that this problem resurgissait, to a lesser extent it is true. We then seemed difficult to draw an effect of roughness on decorrelation in this way.

We then had another idea: instead of taking the papers of different granularities, we decided to take only one and varying the diameter of the diaphragm.

Indeed, if we assume it constant, take different granularities papers like having average sizes of different structures. Moreover, in this case, the speckle size is constant. So this means varying the ratio between the size of structures and size of speckle grains.

Now consider the case where the diaphragm is varied. This variation influences the size of speckle grains but not structures. So this also amounts to varying the ratio between the size of structures and size of speckle grains.

That is why these experiments are almost equivalent. We chose the latter so as not to encounter the problems described above.

We used a black-grained sandpaper 180, which corresponds to a mean grain diameter of 82 μ m. We want to vary the diaphragm so that the size of the speckle grains obtained either:

- half the size of the structures
- twice that of structures

Therefore, for the first case, we seek to have the radius $\frac{82}{2}\frac{1}{2}=20,5\mu m$ and in the second, a radius of $\frac{82}{2}2=82\mu m.$

The size of speckle grains is given by [4-8]:

$$\Delta r = 1{,}22\frac{f}{\phi}(1+M)\lambda$$

It is important to note that Δr represents the radius of the speckle spot.

The above relation, we deduce:

$$\phi = 1,22\,\frac{f(1+M)\lambda}{\Delta r}$$

Where :

$$f = 14cm = 14.10^{-2}\,m$$

$$\lambda = 632{,}8nm = 632{,}8.10^{-9}\,m$$

$$M = 1$$

$$\Delta r = 20{,}5\mu m = 20{,}5.10^{-6}\,m$$

$$\Rightarrow \phi_1 = \frac{1,22.14.2.328}{20,5}10^{-5m} = 1054,46.10^{-5}\,m$$

$$\phi_1 = 1{,}054cm \qquad (2)$$

To calculate found identical to the second aperture:

$$\phi_2 = 0{,}263cm \qquad (3)$$

II. Results

But to get a clearer picture of this decorrelation and also to take account of the aperture, it is necessary to go to the profile of these Fourier transforms.

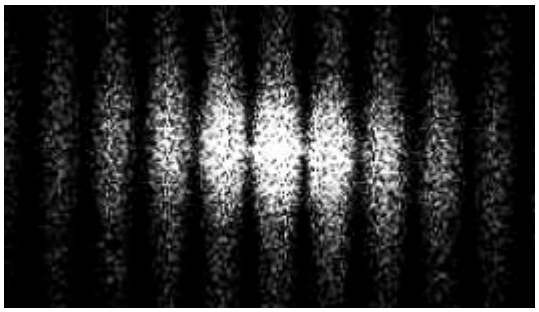


Figure 4 : Profile of the Fourier transform.

We have seen that the Fourier transform of the double exposure as a result gives a modulated spectrum :

$$I \cong 4\left|\tilde{T}\right|^2 \cos^2(\pi k_x \chi)$$

Where χ represents the translation.

For some trigonometric considerations, we can rewrite:

$$\cos^2\alpha = \frac{1+\cos 2\alpha}{2}$$

We will then approximate the profile fringes with Easyplot with an equation like

$$y = \frac{1}{2}(1 + \gamma \cos(fx + g))T$$

- T is the form of non-modulated profile, it is obtained by the Fourier transform to a zero displacement.
- f is the frequency of the fringes.
- g is their phase.

But the point that interests us above all is γ. This is the fringe contrast.

Below we can see the result of approximation by Easyplot for two diaphragms. The curves correspond to a displacement of the object of 0.8 millimeters. One can see that this approximation is good.

We have summarized the results of these approximations in the following tables, where we have only postponed the values of contrast.

a) Diaphragm 10,54 mm :

Displacement (1/10mm)	Paper	Camera	Report	Difference
2	0,814	0,843	0,96559905	0,029
4	0,686	0,723	0,94882434	0,037
6	0,593	0,618	0,95954693	0,025
8	0,464	0,465	0,99784946	0,001
10	0,394	0,465	0,84731183	0,071

Tableau 1: Displacement for the diaphragm of 10.54 mm.

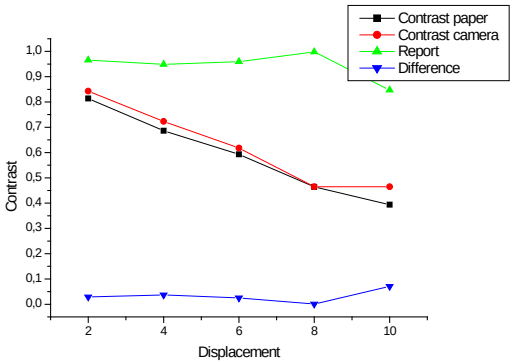
b) Diaphragm 2,63 mm :

Displacement (1/10mm)	Paper	Camera	Report	Difference
2	0,814	0,892	0,91255605	0,078
4	0,613	0,717	0,85495119	0,104
6	0,562	0,732	0,76775956	0,170
8	0,470	0,610	0,7704918	0,140
10	0,307	0,535	0,57383178	0,228

Tableau 2 : Displacement for the diaphragm of 2.63 mm.

III. Discussion

Below, we have plotted the contrast. For each aperture, we find a curve for the contrast when moving the object (sandpaper), another curve for the contrast related to the movement of the camera and finally, a curve for the ratio of these two contrasts (paper/camera).



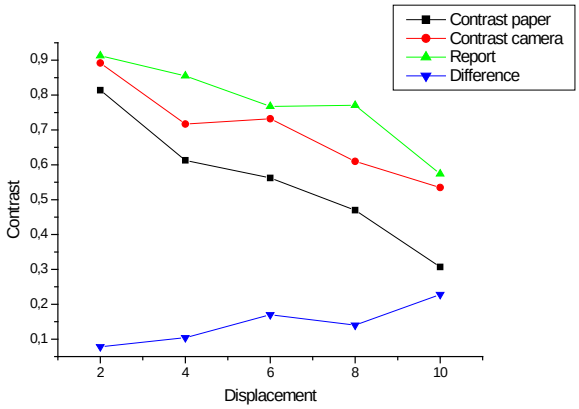


Figure 5 : Contrast of an opening.

a- 10.54 mm

b- 2.63 mm

Carry on the same graph the contrast ratio (paper / camera) for the two f-stops. Do the same with the difference contrasts (camera-paper). We see that the ratio decreases more rapidly for the smallest opening, as well as the difference increases faster in this case.

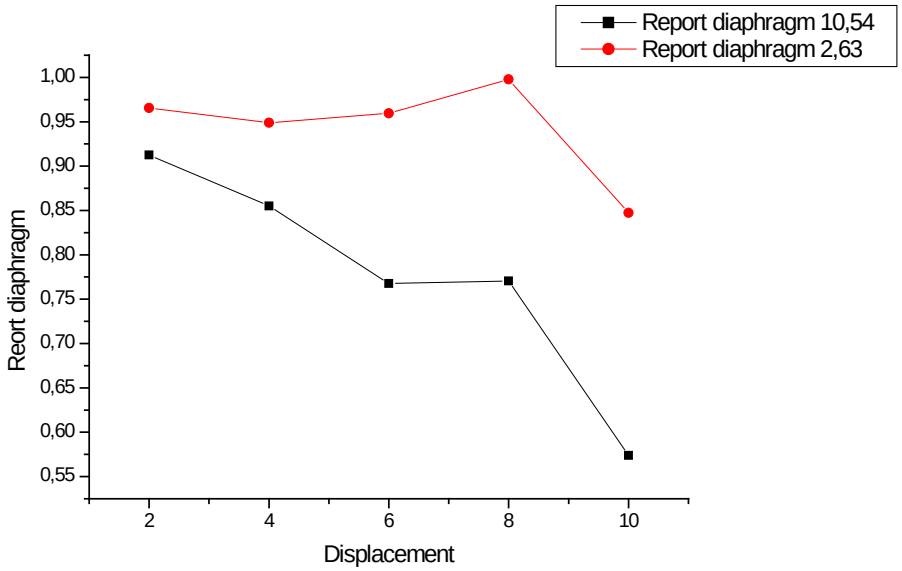


Figure 6 : Contrast ratio for the two openings.

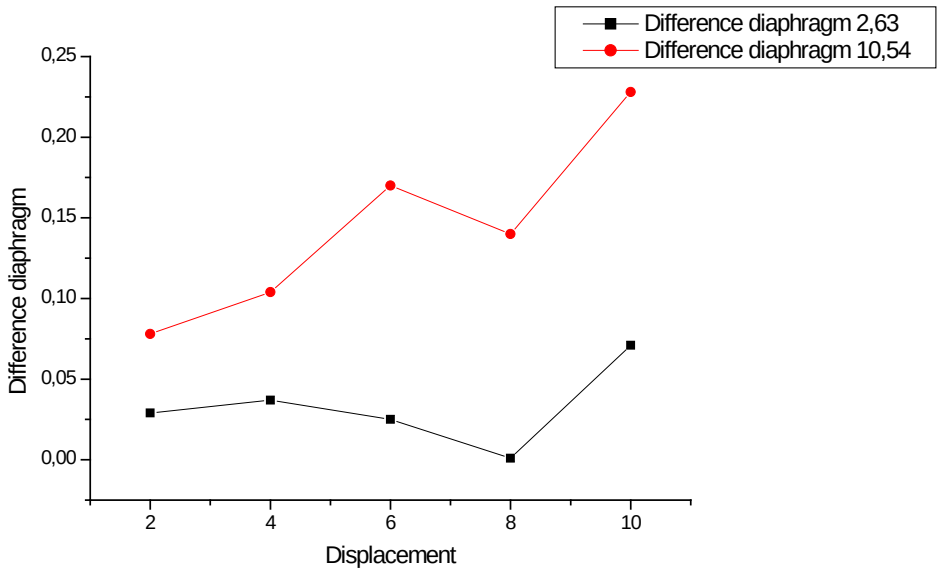


Figure 7 : Difference in contrast to the two openings.

IV. Conclusion

Using the charts above, we can notice that the decorrelation of the speckle is more pronounced when the diaphragm is closed. In other words, we can say that the speckle decorrelation is greatest when, at the image plane, the speckle is predominant in relation to structures of the object studied.

Conversely, we can conclude that we will see a decorrelation faster when the structures of the object are a minority compared to the holography, ie when the roughness of the object studied is low. Schematically: roughness decorrelation.

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Uptake of Heavy Metals by Channa Punctatus from Sewage-Fed Aquaculture Pond of Panethi, Aligarh

By Mehjbeen Javed & Nazura Usmani
Aligarh Muslim University, Aligarh India

Abstract - Investigations on the bioconcentration of heavy metals (Cu, Ni, Fe, Co, Mn, Cr and Zn) were observed in Channa punctatus. The results revealed that heavy metals available in water were in the order Fe > Mn > Zn > Co > Ni > Cu = Cr. The accumulation was also observed in tissues such as gills, liver, kidney, muscle and integument. Their pattern of accumulation in muscle was Fe > Zn > Mn > Cu > Cr > Ni > Co. All the heavy metals showed maximum concentration and persistence in gills with the exception of Cu and Co, which showed maximum accumulation in liver and muscle respectively. Fe was the most abundant metal in the water as well as in the fish tissues. Significant ($P < 0.01$) relations were observed among the metal accumulations in different organs of the fish. The concentration observed was far exceeding the recommended limits of FAO/ WHO.

Keywords : *Bioconcentration, Heavy metals, gills, Channa punctatus.*

GJRE-C Classification : *FOR Code: 090409*

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I. Introduction

Human activity has continuously disturbed the natural environment, particularly the aquatic ecosystems. The use of heavy metals in industries has lead to the wide spread environmental contamination. Consequently the waste water from industries and also the sewage water from domestic sources containing heavy metals find their way into the nearby water bodies. The aquatic pollution due to heavy metals is of major concern, due to their persistence and accumulative nature. Aquatic animals live in very intimate contact with their environment thus, absorbed heavy metals from the surrounding contaminated water which ultimately affect their health. Among these animal species, fishes are the inhabitants that cannot escape from the detrimental effects of these pollutants (Olaifa et al., 2004) and are therefore very susceptible to physical and chemical changes which may be reflected in their blood components (Wilson and Taylor, 1993). The studies carried out on various fishes have shown that these metals alter the physiological activities and biochemical parameters both in tissues and blood (Canli, 1995; Basa and Rani, 2003). The accumulation of trace metals in a fish tissue depends mainly on the concentration of the metal in the water and exposure period. It is therefore necessary to examine their distribution in different fish tissues to understand their physiological, toxicological and hygienic effects. The metal once absorbed is transported by the blood to either a storage point, such as bone or to the liver for transportation. If transported by the liver it may be stored there, excreted in bile, or passed back into the blood for possible excretion by kidney or gills or stored in extra hepatic tissues such as fat. Keeping this in view, a study was conducted to assess the concentration accumulated in different organs of *Channa punctatus* exposed to potentially toxic chemicals in the wastewater. Fish is also provided as a bioindicator of the deteriorating water quality of sewage fed pond.

a) Description of study area

The study pond is located at Panethi (Latitude 27.88969; Longitude 78.07594), in district Aligarh (Uttar Pradesh), India. This sewage -fed pond is situated at a distance of about 1Km from Dairy products processing factory (Rama Dairy). This factory is now banned for last one year, but in the past the waste water used to reach the pond. Few cold stores are also present nearby. This factory supplied the milk and other processed products in Panethi and around the other regions of Aligarh. The waste water from this factory find its way into the study pond via small streams. This pond also received the domestic waste water of communities living in the area. Fishes thriving in this pond fulfill the need of local peoples living around.

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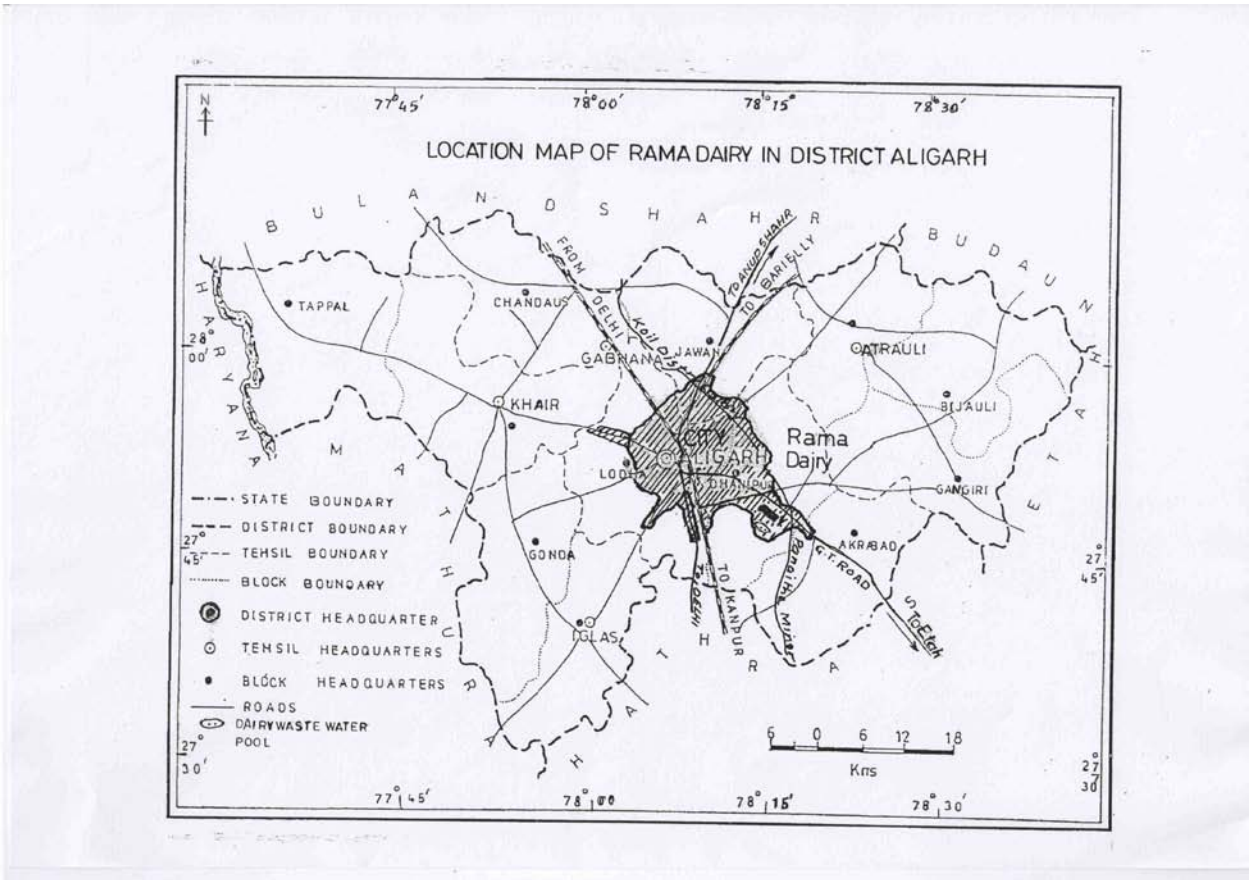


Figure 1 : Location of sewage fed pond (Dairy waste water pool) and Rama Dairy at Panethi, Aligarh.

II. Materials and Methods

a) *Collection and analysis of water sample from sewage fed pond*

Water was collected in a pre-cleaned and acidified glass bottles. The bottles were immediately brought to the laboratory and acidified with concentrated HNO_3 to pH less than 2.0. Water samples were then analyzed for the presence of heavy metals (Cu, Ni, Fe, Co, Mn, Cr and Zn) according to APHA (2005).

On spot fixation of water was done to measure the dissolved oxygen (D.O). Total solids (T.S), total dissolved solids (T.D.S) and suspended solids (T.S.S) were determined using standard techniques (APHA, 2005).The temperature and pH were recorded at the site using laboratory thermometer (Deluxe, 6) and pH strips (S.D Fine chemicals, 0 - 0.1).

b) *Collection and processing of fish samples*

Fish *Channa punctatus*, (stock = 4, n= 5, Mean length 14.20 cm, Mean weight 35.0 g), were collected from the sewage fed pond. Procured fishes were immediately kept in pre-cleaned polythene bags, sealed and stored in an ice box for further analysis. The present study was conducted to investigate the accumulation of heavy metals (Cu, Ni, Fe, Co, Mn, Cr,and Zn) in various tissues (gills, liver, kidney, muscle and integument). Tissues were removed and oven dried at 60 °C. The dried samples were ground into fine powder using pestle and mortar, and sieved (0.5 – 1.0 mm). Tissue samples, (0.5g) were digested in 15 ml of solution containing concentrated HNO_3 and $HClO_4$ (4:1). The digested solution was filtered through Whatmann filter paper (No.42), and washed with distilled water. It was then raised to 50 ml in a volumetric flask (Javed M and Usmani N, 2011).

c) *Preparation of Blank*

Blanks were prepared along with each set of the sample.

d) *Preparation of standards*

Standard solutions for heavy metals were prepared using standard techniques (APHA 2005).

e) *Instrumentation*

The water and fish tissue samples were analyzed for heavy metals Cu, Ni, Fe, Co, Mn, Cr and Zn by Atomic Absorption Spectrometer (Perkin Elmer, AA 800, multiple cathode lamps) with specific cathode lamps for each metal and Nitrous oxide-Acetylene was used as flame. The following analytical conditions of the instrument were used for atomic absorption of these metals.

f) Statistical analysis

Samples were taken in triplicates. The values are given as Mean ± S.D. The data was subjected to ANOVA. Significant differences among the means was calculated using Duncan's multiple range test (Duncan 1955).

III. Results and Discussion

The aquatic environment of the sewage fed-pond, subjected to many stressful factors, heavy metals are one of the serious pollutants that reach the aquatic habitat and also a matter of concern. For this reason, this work is projected to examine the hazardous effects of heavy metal on one of the most common fish species, *Channa punctatus* in the sewage fed-pond of Panethi.

Table 1 presents the data on physicochemical parameters of sewage-fed pond water. Table 2 and figure 2 shows the mean concentration of metals (mg L^{-1}) in water. The heavy metal content in sewage-fed pond water were in the order of Fe > Mn > Zn > Co > Ni > Cu = Cr.

Table 3 revealed concentration of different heavy metals in particular organs of *Channa punctatus.*

Table 4 and figure 3 present accumulation of particular heavy metals in different organs of *Channa punctatus.*

These results indicate that in general gill was the most affected organ where maximum accumulation of heavy metals takes place followed by muscle, kidney, liver and the integument accumulated the least, and amongst the heavy metals Fe accumulated the most in all tissues.

Table 1 : Physicochemical parameters of sewage-fed pond water.

Parameters	Water
Temperature	30.0°C
pH	7.0
Dissolved oxygen (D.O)	5.8mgL^{-1}
Total solids (TS)	1700mgL^{-1}
Total Dissolved solids (TDS)	1500 mgL^{-1}
Total Suspended solids (TSS)	200 mgL^{-1}

Values are Mean, (n= 3).

Table 2 : Heavy metal concentrations (mgL-1) in sewage-fed pond water.

Heavy metals	Water
Cu	0.07± 0.01
Ni	0.08± 0.02
Fe	8.08± 2.88
Co	0.24± 0.02
Mn	2.32± 0.10
Cr	0.07± 0.02
Zn	0.45± 0.03

Values are Mean ± S.D, (n= 3).

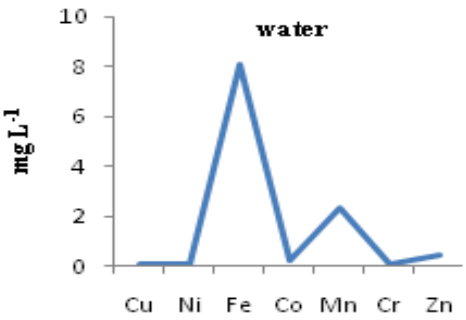


Figure 2 : Heavy metal concentration in sewage-fed pond water, Panethi, Aligarh.

Table 3 : Concentrations of different heavy metals in particular organs of *Channa punctatus.*

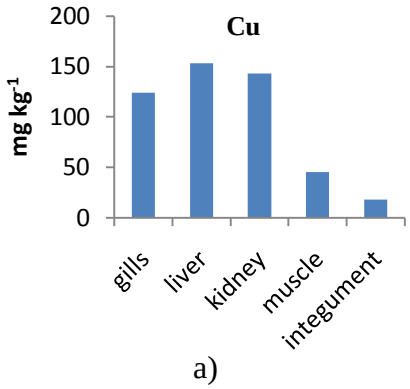
Heavy metals↓	Gills	Liver	Kidney	Muscle	Integument
Cu	123.80^{d}±4.12	153.33^{c}±7.29	143.33^{c}±5.77	45.33^{d}±0.57	18.33^{d}±0.57
Ni	30.95^{f}±1.73	ND	ND	18.33^{f}±0.09	11.33^{e}±0.57
Fe	17609.38^{a}±4.12	14533.13^{a}±0.5	3543.76^{a}±0.68	5313.29^{a}±0.31	875.33^{a}±0.31
Co	ND	ND	ND	1.33^{g}±0.06	1.33^{g}±0.05
Mn	1359.51^{c}±0.62	ND	ND	83.28^{c}±0.06	22.31^{c}±0.57
Cr	66.66^{e}±2.43	13.33^{d}±5.76	10.00^{d}±0.00	29.33^{e}±1.96	6.33^{f}±0.02
Zn	1845.22^{b}±0.57	873.31^{b}±6.06	1163.33^{b}±5.72	319.29^{b}±0.18	257.11^{b}±0.10

Values are Mean ± S.D, (n= 3), ND= not detected, Values are expressed in mgkg-1.dry weight
Means with similar letters in a column are statistically similar at P > 0.01

Table 4 : Concentrations of particular heavy metal in different organs of *Channa punctatus*.

Heavy metals↓	Gills	Liver	Kidney	Muscle	Integument
Cu	123.80^{c}±4.12	153.33^{a}±7.29	143.33^{b}±5.77	45.33^{d}±0.57	18.33^{e}±0.57
Ni	30.95^{a}±1.73	ND	ND	18.33^{b}±0.09	11.33^{c}±0.57
Fe	17609.38^{a}±4.12	14533.13^{b}±0.5	3543.76^{d}±0.68	5313.29^{c}±0.31	875.33^{e}±0.31
Co	ND	ND	ND	1.33^{a}±0.06	1.33^{a}±0.05
Mn	1359.51^{a}±0.62	ND	ND	83.28^{b}±0.06	22.31^{c}±0.57
Cr	66.66^{a}±2.43	13.33^{c}±5.76	10.00^{cd}±0.00	29.33^{b}±1.96	6.33^{d}±0.02
Zn	1845.22^{a}±0.57	873.31^{c}±6.06	1163.33^{b}±5.72	319.29^{d}±0.18	257.11^{e}±0.10

Values are Mean ± S.D, (n= 3), ND= not detected, Values are expressed in mgkg-1.dry weight
Means with similar letters in a row are statistically similar at P > 0.01



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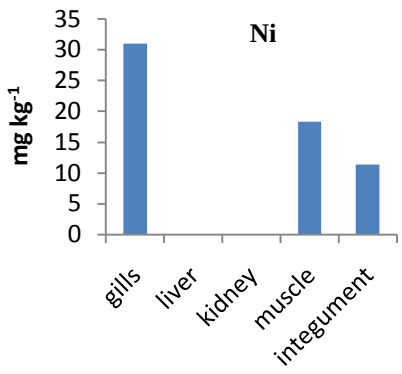

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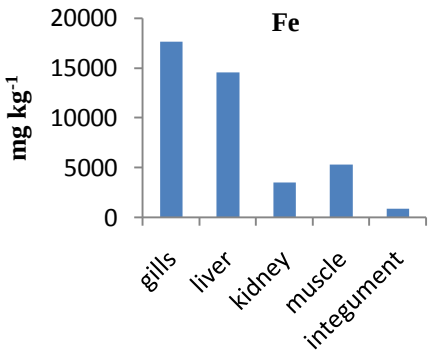

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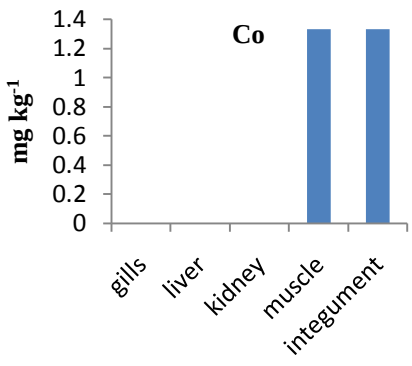

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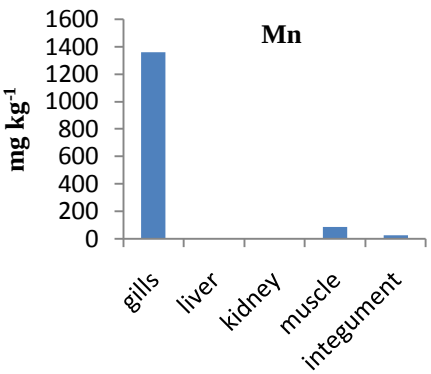

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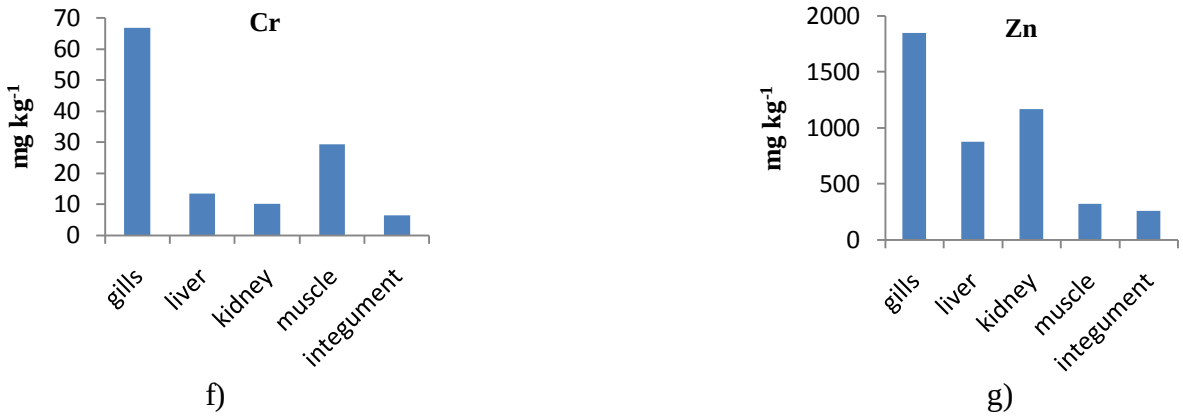

Figure 3 : a,b,c,d,e,f,g showed mean metal (Cu, Ni, Fe, Co, Mn, Cr and Zn) concentrations ($mgkg^{-1}$.dw) in gills, liver, kidney, muscle and integument of *Channa punctatus.*

Fe was the most abundant heavy metal in all tissues of *Channa punctatus*, but its highest value was observed in gills followed by liver > muscle > kidney > integument (Table 4) Studies reported in *Oreochromis niloticus* and *Lates niloticus* (Mohamed, 2008), *Oreochromis mossambicus* (Robinson and Avenant-Oldewage, 2006) *Liza aurata, Mugil cephalus, Liza ramada* (Uysal et al., 2008) also revealed the maximum accumulation of Fe in gills. Highest accumulation in gills indicates that these are the organs which always remain in direct contact with the surrounding water. However in other studies the highest accumulation seen in organs such as liver in the fishes *Clarias gariepinus* (Osman et al., 2010) and *Tinca tinca* (Selda Tekin et al., 2005). In the pond water also the Fe concentration was maximum, therefore maximum uptake of this metal takes place by the fish tissues.

Fe accumulation was followed by Zn in the present study where the values were observed to be highest in gills followed by kidney > liver > muscle > and least in integument. Other scientist also reported the highest concentration in gills of *Channa punctatus* (Vineeta Shukla et al., 2005). These high levels in gill tissue can possibly due to the fact that they are the main sites for Zn uptake, particularly in fresh water fish and due to the large surface area that is in contact with environmental water and the very thin membrane separating the external and internal media of the animal. The large surface area of gills in *Channa punctatus* (Karuppasamy, 2000) may be favour for metal uptake. Zn content in gills of investigated species was comparable to *Labeo* dyocheilus (Yousafzai et al., 2010). Other workers, however noticed the highest concentration in organs such as liver of *Channa punctatus* (Murugan et al., 2008) and *Clarias gariepinus* (Osman et al., 2010), testes of *Oreochromis niloticus* and *Lates niloticus* (Mohamed, 2008) and integument of *Labeo dyocheilus* and *Wallago attu* (Yousafzai et al., 2010). In this study, it was also observed that Zn content in liver was higher than muscle. The lower Zn content in muscle may be because the excessive Zn in muscle was transferred to other fish organs when exposed to Zn contaminated system (Madhusudan et al., 2003). This deloading ability of fish has been reported to be advantageous to fish consumers (Murugan et al., 2008). The permissible limits for Zn set by WHO/FAO (1989) is 40 ppm which is much less than the values observed during the study (Table 5).

In the present study, Mn accumulation was significant in tissues and showed accumulation in the order of gills > muscle > integument. It was not observed in liver and kidney. Though, in water its availability was considerably high. Studies reported in *Tinca tinca* (Selda Tekin et al., 2005), *Oreochromis mossambicus* (Robinson and Avenant-Oldewage, 2006), *Clarias gariepinus* (Osman et al., 2010) and *Labeo rohita*, also revealed the highest concentration of Mn in gills (Javed and Usmani, 2011). However, other workers reported the highest concentration in organs such as kidney and muscle of *Channa punctatus* and *Clarias gariepinus* respectively (Javed and Usmani, 2011). However in other studies the Mn content reported in different tissues was much lower than the present study. Mn is an essential micronutrient (Dallas and Day, 1993) and does not occur naturally as a metal in aquatic ecosystems, but is found in form of various minerals and salts. According to the Department of Water Affairs and Forestry (1993), the main route of Mn adsorption occurs through the respiratory and gastrointestinal tracts. The adsorption of Mn in the digestive tract is inversely related to Ca^{++} levels in the diet of organism. The permissible limits for Mn set by WHO(1985) is 0.01ppm which is well below the accumulation observed during the study (Table 5).

Copper exhibited highest content in liver and lowest in integument of the investigated species and the pattern observed was liver > kidney > gills > muscle > integument. Other workers also reported the highest accumulation of Cu in liver of fishes *Oreochromis mykiss* and *Cyprinus carpio* (De Boeck et al., 2004), *Tilapia nilotica* (Abdel-Baki et al., 2011), *Oreochromis niloticus* (Mohamed, 2008), *Wallago attu* and *Labeo*

dyocheilus (Yousafzai et al., 2010). According to Stokes (1979), liver and kidney have Cu bioaccumulation properties, with the accumulative capacity much greater in liver than in kidney which is evident from the present study (Table 4). Cu accumulation exhibited in liver corroborates to the findings in *Cyprinus carpio* (De Boeck et al., 2004), *Oreochromis mossambicus* (Robinson and Avenant-Oldewage, 2006). Cu content in muscle corroborates to the *Heterotis niloticus*, *Clarias gariepinus* (Anim et al., 2010), *Wallago attu* (Yousafzai et al., 2010). According to Stokes (1979) fish muscle has poor accumulative properties, with low concentration of Cu found in the muscles, even systems containing high Cu levels. Present study reports low levels of Cu in water (Table 2). However, other scientists confirmed highest levels in organs such as kidney of *Channa punctatus, Clarias gariepinus* and *Labeo rohita* (Javed and Usmani, 2011), gills of *Channa punctatus*(Vineeta Shukla et al., 2005) and *Lithognathus mormyrus* (Uysal et al., 2008). In the present study the content of Cu observed in integument is similar to our earlier findings in *Clarias gariepinus* and *Labeo rohita* (Javed and Usmani, 2011). The amount of Cu accumulation observed during the present study is little higher than the permissible limits set for Cu by WHO/FAO (1989) which is 30 ppm (Table 5).

In the present study the concentration of Cr and Cu in water was exactly similar (Table 2), but fish showed different response to these metals (Table 3). It indicates that even in lower amounts Cu has more absorptive and accumulative capacity than Cr under similar natural environment. Cr present in highest amounts in gills followed by muscle and least was in integument. While liver and kidney showed insignificant accumulations. Various studies conducted on Cr also noticed highest concentration in gills of *Labeo dyocheilus* and *Wallago attu* (Yousafzai et al., 2010). However, the highest concentration was also reported in other organs such as in kidney of *Clarias gariepinus* and integument of *Labeo rohita* (Javed and Usmani, 2011), liver of *Clarias gariepinus* (Osman et al., 2010), kidney of *Tilapia nilotica* (Abdel-Baki et al., 2011), liver of *Oreochromis mossambicus* (Robinson and Avenant-Oldewage , 2006). The observation that was made for Cr accumulation in kidney was comparable to *Clarias gariepinus* and *Labeo rohita* (Javed and Usmani, 2011). Concentration in integument corroborates to *Channa punctatus* (Javed and Usmani, 2011). Duffus (1980) and Paasivirta (1991) both regard Cr in its salt form as highly bioaccumulative at high concentrations, and partially dangerous.

Ni occupied the sixth position as far as accumulation was concerned. The order of nickel accumulation observed during the study was gills > muscle > integument. It was not detected in liver and kidney. Other workers also revealed the highest levels of Ni in gills of fishes *Cyprinus carpio* (Vinodhini and Narayanan, 2007), *Catla catla* and *Heteropneustes fossilis* (Abida et al. 2009), *Wallago attu* (Yousafzai et al. 2010). Ni has a similar chemical behaviour to Fe and Co and commonly substitutes for Fe in ferromagnesian minerals. Gold fish (*Carassius auratus*) that died during immersion in solutions containing more than 35 mgL^{-1} Ni showed elevated concentration in tissues, however, most of nickel was washed off with water, and it is not clear if accumulation occurred after death (Kariya et al.1968). Concentrations of Ni in water from natural occurences are only likely to be of health concern in environments where pH is less than 4.5. The amount of Ni accumulation observed during the present study is within the permissible limits set for Ni (70 – 80 ppm) by USFDA (1993b).

Co was the least accumulated metal in tissues of *Channa punctatus*. Its accumulation was noticed only in muscle and integument while in gills, liver and kidney it was untraceable. Co was also not detected in gills and kidney samples of fishes *Clarias gariepinus, Cyprinus carpio* and *Oreochromis niloticus* (Adeyeye et al., 1996). Ca^{2+} competition and dissolved organic matter complexation were the most important factors preventing Co^{2+} from binding at the gills in natural water.

To summarize, these results indicate that the fish *Channa punctatus*, as a representative fish species of sewage-fed aquaculture pond, can be a useful vertebrate bio-indicator organisms of heavy metals contamination in water. This species is also a highly sensitive type to heavy metal pollution in the environment.

Table 5 : Permissible limits of heavy metals set by various food agencies in fish and fishery products.

Heavy metals	Muscle ($mgKg^{-1}$.dw)	Integument ($mgKg^{-1}$.dw)	Average*	Permissible limits (ppm)
Cu	45.33	18.33	31.83	30 (WHO/FAO 1989)
Ni	18.33	11.33	14.83	70-80(USFDA 1993b)
Fe	5313.29	875.33	3094.31	
Co	1.33	1.33	1.33	
Mn	83.28	22.31	52.79	0.01 (WHO 1985)
Cr	29.33	6.33	17.83	-
Zn	319.29	257.11	288.2	40(WHO/FAO 1989)

** At times integument is also consumed with fish muscle therefore, average is taken.*

Blank cells indicate that no citable information is available.

IV. Conclusions

This study was carried out to provide information on toxic heavy metal concentrations in *Channa punctatus* from sewage- fed aquaculture pond, India and potential health risk for local population due to their consumption. The majority of heavy metal concentrations in the fish samples analyzed were exceeding the permitted limits set by various authorities and will pose health risks for the local population due to high consumption of fish.

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3. Submission of Manuscripts,

4. Manuscript's Category,

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Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to

shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.
- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic

principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.

- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

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- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

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- Submit to work done by specific persons (including you) in past tense.
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Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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