Covenant University
2nd Inaugural Lecture

"MONO-METALLIC REFORMING CATALYST LIFE AND MORTALITY: A REPLICA OF HUMAN LIFE AND A PANACEA TO BETTER HEALTH"

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INTRODUCTION

REACTIONS AND TYPES

Reaction in chemistry has to do with a chemical transformation taking place with atoms or molecules (compounds) or their combinations. Since there is usually a change in energy level, reaction is usually accompanied by heat absorption (Endothermic Reactions) or heat evolution (Exothermic Reactions). On a daily basis, apart from reactions that are initiated by man, there are scores of natural reactions taking place on routine basis. The existence of man and other living things are dependent on some of these naturally occurring reactions. Failure of such reactions means termination of life on earth. Some of these natural reactions include: Photosynthesis: a form of photochemical reaction upon which plants life depend; the absorption of the ultraviolent rays beyond the atmosphere by ozone leading to the formation of oxygen that is essential to life on earth; the formation of mineral oil from the transformation of cellulose under intense temperature and extreme pressure underneath the earth surface which is the basic raw material to most domestic and industrial products, and few other ones. Most household and office equipment today are products of chemical reactions While many of these reactions occur naturally at reasonable rates, some even violently, a good number of reactions that produce useful household and industrial products only occur at appreciable level with the aid of catalysts.

Most of the Chemical Reactions occurring in the Refinery and Petrochemical Industry are catalytic in nature. One of the most common Catalysts, is the reforming catalyst, ie Platinum- Alumina (Pt/Al_2O_3). Every batch of Catalyst used has a life span after which it becomes too weak and inefficient and therefore needs to be replaced. This, we describe as the mortal state.

The replacement cost of the reforming Catalyst in the oil refining industry, after its final deactivation and mortality, is exorbitant and constitutes a major factor in the pricing of the relevant downstream oil industry products. This work therefore investigated the principle of deactivation by coking leading to the mortality of Platinum Alumina Catalyst (Pt/Al_2O_3).

Catalyst:

What is catalyst? A Catalyst is a substance that alters the rate of a chemical reaction without itself undergoing any permanent chemical change. For example, A powerful official that hastens the processing of an application that has taken upward of a year, without any string attached, has played the role of a Catalyst.

Catalyst activity is described as positive when it increases the rate of reaction; an example is manganese dioxide that increases the rate of formation of potassium chloride from potassium chlorate. Conversely, Alcohol plays the role of a negative catalyst by retarding the rate of oxidation of chloroform to poisonous phosgene (Senerpati, R M, 2006). There are numerous household and industrial products today obtained from various catalytic reactions in the downstream petroleum industry. Catalyst exist both in liquid and solid states. When a catalyst operates in the same phase (liquid or gas) with the reactants, we describe its operation as homogenous. However quite a number of useful catalytic reactions occur in heterogeneous manner where the catalyst is solid while the reactants are either liquids or gases or both. Solid catalyst consists of porous solid matrix with great surface area upon which the active catalytic sites are grafted

Solid Catalysts:

The operation of solid catalyst like any surface reaction is complex. One of the complexities is in the development of the rate of reaction

equation. Unlike the homogenous reactions system, the effect of mass and heat transfer resistances are enormous and need to be accounted for in the development of the rate of reaction equation.

The second complexity is the challenge of maintaining clean assessable active reaction sites of the catalyst as the reaction progresses. This is the focus of this inaugural lecture. Generally, the rate of solid catalysed reaction depends on:

(a) Surface kinetics or rate of reaction on the surface of the catalyst. (changes with deactivation of the catalyst)

(b) Resistance to pore diffusion of reactants into the catalyst leading to concentration gradient along the pore length.

In addition to these, the formation of a fouling coke by-product on the surface of the active sites is another major resistance to reaction that can be so severe and dominant to the extent of causing the catalyst to become impervious, thus terminating the reaction entirely. The catalyst is said to be deactivated when this occurs. After a period of reaction, there is the need to clean off the fouling cokes through burning with oxygen before another cycle of reaction. This step is called Reactivation.

In each cycle of reaction, the conversion to product starts from an initial high level and decreases steadily to such a low level when another reactivation of the catalyst is required. This Deactivation – Reactivation cycle continues to a point of mortality of the catalyst where the above usual reactivation procedure fails to revive the catalyst. At this point the catalyst is said to be dead and it is removed and replaced with a new one. The objective of this work was to study the Deactivation – Reactivation processes in order to understand the causes of catalyst mortality - why the reactivation step fails to revive the catalyst.

REVIEW OF PREVIOUS WORKS ON CATALYST DEACTIVATION.   CAUSES OF DEACTIVATION:

Although we have examples of catalyst deactivation resulting purely from the physical coverage of the active metal sites by coke molecules, there are still doubts as to whether electronic factors are responsible for Catalyst deactivation as coke get deposited on the active sites. Agrawal etal (1980) stated that, if deactivation is due to reduction in the number of active sites then the kinetic behavior should remain unchanged with deactivation and the reduction in the rate constant will then be attributed to the fractional reduction in the number of active sites. However, if deactivation is due to electronic factors, the value of the kinetic parameters would be expected to change on deactivation and this will provide a new insight into deactivation mechanism.

The effect of the coke deposit level on the activity of the catalyst, form the basis for the empirical equation derived by various authors like Froment and Bischoff (1961) and, Dumez and Froment (1976). They have shown the need to relate activity of a coked catalyst through an empirical equation to the coke content of the catalyst and to relate the coke content to the properties of the catalyst through a continuity equation. Cooper and Trimm (1980) also gave a model relating activity to the coke content of the catalyst.

It is on the basis of this view that the kinetic behavior of Pl/Al_2O_3 catalyst, on deactivation, was investigated using the kinetic modeling equations of Omoleye and Susu (Omoleye, J A., 1987) –a modified form of the combination of Froment Model, and Corrella and Asua model.

The results of the kinetic parameters obtained using our model on deactivating Platinum Alumina Catalyst shall be used, along with the submission of Agrawal et- al to confirm if the decline in activity of

deactivating catalyst is purely due to sites coverage by cokes or due to some electronic changes or combination of the two.

DEACTIVATION MODELS

The deactivation models are equations derived using certain reaction variables to predict the rate of formation of coke on the Catalyst active sites as reaction progresses with time.

(I) Voorhees's Model

The model given as:
$$N_c = at^n \text{ -------------- ---------------- ---------------------------------(1)}$$
relates the quantity of coke, N_c deposited on the catalyst sites as an exponential function of time of deactivation, **t**; **n** and **a** being constants (Voorhees A, 1946). This model has two short comings; other researchers like Eberly etal (1966), Dumez and Froment (1976) show the inconsistency of the model with respect to constant n especially with change in flow rates of reactants. Moreover the model is not a rate law from which the mechanism of coke formation can be derived and understood.

(Ii) Levenspel's Model (1972):

(Ii) Levenspel proposed a series of models based on sound theoretical principles, but they cannot be used for this work for the following reasons:

(a) the of equation is based on a simple reaction system, while the reaction used in this work, the dehydrogenation of cyclohexane, on Pt/Al_2O_3 catalyst is best described by Langmuir Hinshelwood equation.

(b) The assumption of a constant reactants concentration is not applicable to the activity of most deactivating catalyst which depends on the concentration of the reactants (pg 2.9). This condition of constant reactant concentration will be very laborious to attain in reality under a laboratory experimental condition.

© While Levenspiel's model provides information on the order of coke reaction, it does not provide information on the number of active sites

involved in the main coking reactions.

(d) The model does not propose mechanisms leading to deactivation.

(iii) Froment's Model (1980):

Froment (1980) developed two models for the catalyst deactivation by coking; one describing catalyst by purely active site coverage another describing the deactivation by both active site coverage and pure blockage by coke. This model offers quite a lot of information useful in the study of changes in the physical properties of the catalyst with time of deactivation. The model, as at the time of this work, had not been used practically. If successfully used, it has some advantages over the previous models in providing information on some properties of the catalyst's structure like the number of active sites per micro pore and the ratio of micro pore and macro pore in the catalyst and how they affect the deactivation of the catalyst.

(iv) Corrella and Asua's Model:

The model of Corrella and Asua (1982) is based on a parallel coking, non-simple reaction system. This model is very comprehensive and informative. A lot of deactivation parameters useful in analyzing specific mechanism of catalyst deactivation are obtainable. However, only two models: d-1 and d-2 mechanisms will be used in this work since other types contain some intermediate complex absorption coefficients without any clue for their determination. The model also applies Langmuir Hinshelwood rate equation applicable to most catalyst deactivation reactions. The model incorporates some important parameters like; m (no of active sites involved in the rate controlling step of the main reaction), n (no of free gas molecules involved in the coking reaction), h (no of active sites involved in the rate controlling step of the coking reaction) as well as the fresh catalyst kinetic constant K (reaction constant) and K_A. (deactivation constant).

(v) Cooper and Trimm's Model.

Cooper and Trimm improved on the work of Froment (1980) by introducing the dependence of deactivation function on the number of coked sites of the catalyst. For different orders of coking reaction (0, 1, 2), they derived expression for the deactivations function either with single or dual site mechanism. As good as this model is, the need for the number of coked sites in the equation, which is an impossible task, makes it of no practical application. Also the neglect of the number of free reactant molecules n in the model will likely introduce some errors.

(Vi) Omoleye and Susu's Model, 1986.

The models above have one limitation or another as mentioned earlier. However, there is no limitation that is not taken care of by one model or another amount those described. In this Model, we have incorporated the coking mechanism of Froment (1976), Corrella and Asua (1982) and combined them with a modified model of Cooper and Trimm (1980) to arrive at a model that is comprehensive and adequate enough for this study. The model of Omoleye and Susu in terms of measureable variables is given by (Omoleye, J A., Susu, A. A. 1989):

$$\emptyset_A{}^{(n-h-1)/m} = \alpha(h-n+1)k_C k_A{}^h / C_t{}^{(n-h-1)} \int [C_A{}^{(n+h)}/(1+k_A C_A)^h]dt + 1$$

Where: h=no of active sites involved in rate controlling step of coking reaction. n= number of free gas molecules involved in coking reaction. m= no of sites involved in the rate controlling step of the main reaction

h = no of sites involved in the rate controlling step of the coking reaction

d= order of deactivation or (m+h+1-n)/m

. $\qquad$ C_A = concentration of reaction = $Cao(1+xA)/(1+AxA)$

ε_A = (for this work) = $3y_{Ao}x_A = 0.699x_A$

K_c = rate of reaction constant

K_A = adsorption constant

Plotting $\emptyset_A^{(n-h-1)/m}$ against $\int[C_A^{(n+h)}/(1+k_AC_A)^h]dt$ **gives** a linear graph with an intercept of unity when the right values of n, m and h are used. The use of this model will provide insight into the mechanism of coke formation as well as causes of catalyst deactivation and mortality. This model is based on the following coking reaction mechanism (Froment 1976), Corrella and Asua (1982).

$A = A*$ --- (1)

$nA + hA* \;\text{---}\; P1h*$ (rate controlling) -- (2)
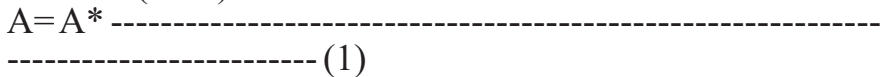
$p^{1h}* = p^{2h}* = p^{3h}*$ -- (3)

$p^{n_1}h* \;\text{---}\; p^{n_1} + h^*$ where n1 = 1, 2, 3 etc.------------------------------------- (4)

m = Number of sites involved in the rate controlling step of the main reaction. $\emptyset_A$ = the activity of the main reaction (fractional conversion of resistant to product at a given time).

h = number of activities involved in the rate controlling step of the coking reaction. n = number of free gas molecules involved in the coking reaction. The rate of controlling step reaction can be represented by the Langmuir Hinshelwood rate equation from where the final deactivation modeling equation was derived:

$$\emptyset_A{}^{(n-h-1)/m} = \alpha(h-n+1)k_C k_A{}^h/C_t{}^{(n-h-1)} \int [C_A{}^{(n+h)}/(1+k_A C_A)^h]dt + 1 \text{ ------- } (5)$$

Fig. 1: THE EQUIPMENT SET-UP FOR EXPERIMENT
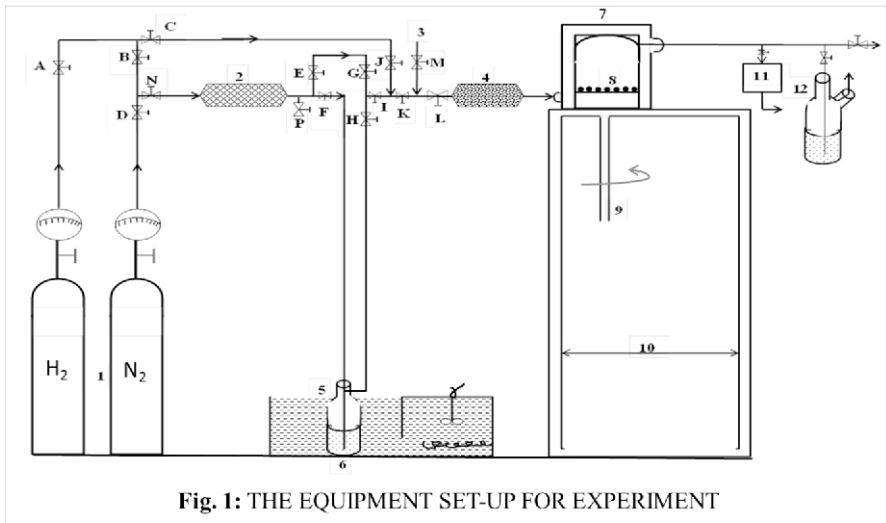
1. GAS CYLINDER	7. REACTOR
2. OXYGEN TRAP	8. CATALYST BED
3. INDUSTRIAL AIR	9. MAGNETIC STRIPPER BED
4. MOLECULAR SIEVE	10. REACTOR STANDS
5. CYCLOHEXANE BOTTLE	11. GAS CHROMATOGRAPH
6. CONSTANT TEMPERATURE WATER BATH	12. BARIUM HYDROXIDE BOTTLE.

EXPERIMENTAL WORK

As mentioned earlier under the Introduction, solid catalyzed reactions like many other solid phase reaction, are subject to both mass and heat transfer resistances. In Fig!: to eliminate these resistances in this work, the Berty-type Continuous Stirred Tank Reactor, CSTR with electronic temperature controller manufactured by Autoclave Engineers was used. The concentration of the feed was maintained constant by maintaining the Cyclohexane saturator temperature constant at $39^{\circ}C$ with the aid of a thermostat controlled water bath. The flow rate of the reactant was varied as required by increasing or decreasing the volumetric flow rate of the Nitrogen carrier gas.

Series of reactions were carried out at various concentrations and temperatures with intermittent reactivation processes until the final mortality of each batch of catalyst was achieved. Proprietary reactivation process was then devised to rejuvenate the catalyst.

The parameters monitored include: concentrations of cyclohexane and benzene with time of reaction, quantity of coke deposited after each reaction cycle.

DATA PROCESSING

The monitored data were analyzed with the aid of developed software. From the electronic computation, n, m, h and Activity with respect to time were obtained.

The summary of the results are as shown on Figs 2 to 6:

THREE STABILITY STATES:

The results of this investigation show clearly there are three stability states in the life of Pt/Al$_2$O$_3$ before its mortality.
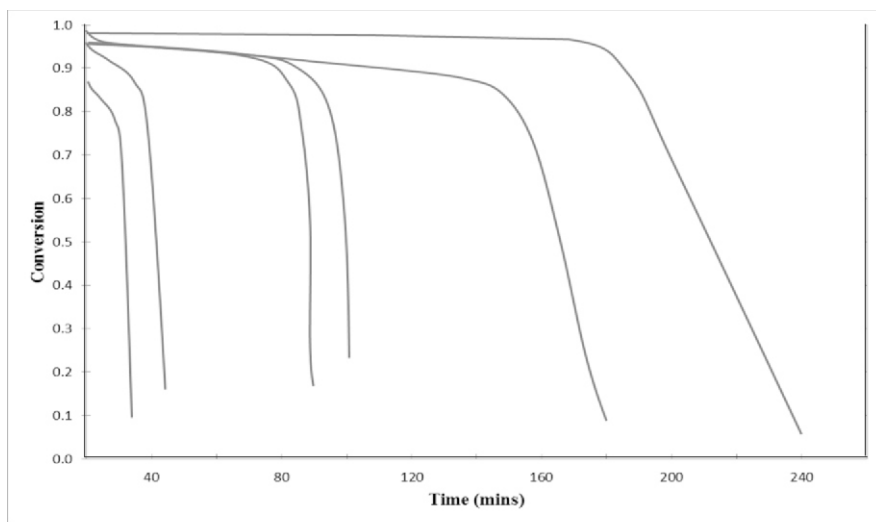

Fig. 2: Conversion vs Time of Reaction (Pt /Al$_2$O$_3$ at 430°C).

(a)   Fig2 is the plot of conversion of Cyclohexane to Benzene against time of reaction for the 22 cycles in the life of that batch of catalyst. The 22 cycles fall into three clear groups differentiated by their cycle lives. Cycles 1 to 7 is the first, the infant group with cycle life less than 45minutes, Cycles 9 to 18 is the adolescent group with cycle life jumping from 45 to between 85 and 100minutes, while the third group or adult group from cycle 19 to 22 has cycle life jumping to between 180 and 240minutes.
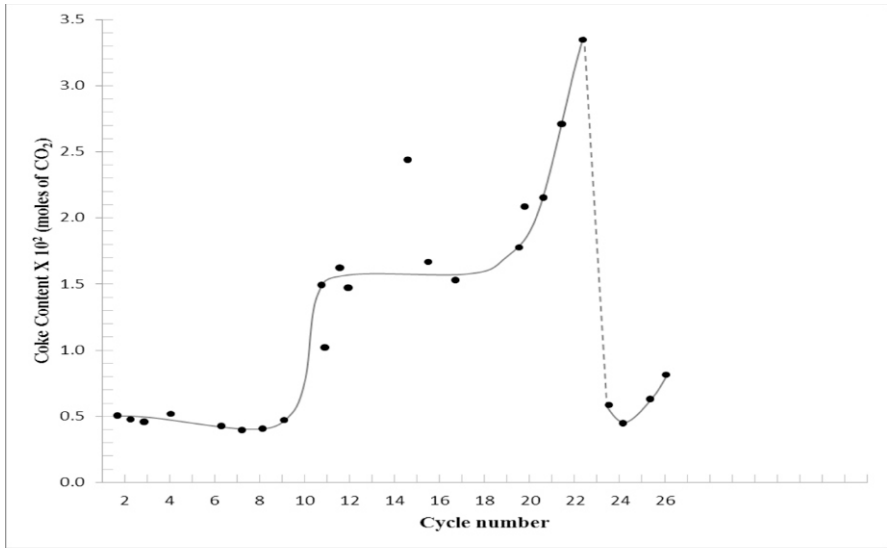
Fig. 3: Coke Content vs Cycle Numbers (Pt /Al_2O_3 at 430°C).

(b) fig3, is the plot of the quantity of deposited fouling Cokes per cycle against the cycle numbers in their chronological order (Omoleye, J A., Susu, A. A. 1986). These graphs just like fig1, also clearly show the same three Stability states. Stability state 1 from cycle 1 to 8 having about 0.004mole Carbon dioxide equivalent of Coking level, stability state2 from cycle 10 to 17 with about 0.012 mole Carbon dioxide equivalent of coking level and Stability state3 from cycle18 to 22 with Carbon dioxide equivalent of coking level above 0.02 mole.
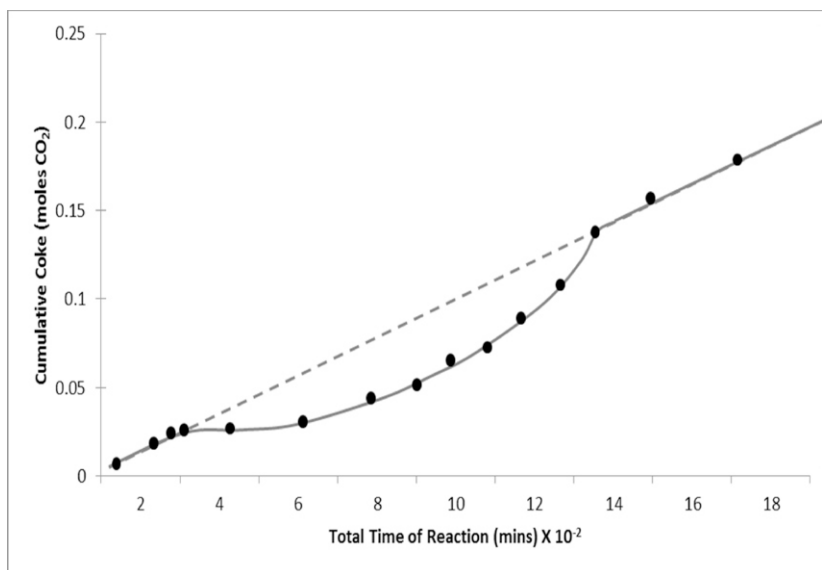
Fig. 4: Cumulative Coke Content vs Total Reaction Time (Pt /Al$_2$O$_3$ at 430°C).

(c)   Fig.4 is the Plot of cumulative Coke deposit on the Catalyst surface versus total time of reaction. This plot also shows the existence of three distinct stability states in the life time of Pt/Al$_2$O$_3$ catalyst.

It can therefore be concluded from the above observations that three stages of life: Infancy, Adolescence and Old age, exist in the life time of Pt/Al2O3 catalyst as it exists in human life. The adolescent age, as in human life, dominates the life time of the catalyst while the other stages of life were brief.

(d)   Both the main and coking reactions in the dehydrogenation of Cyclohexane to Benzene are influenced by temperature.
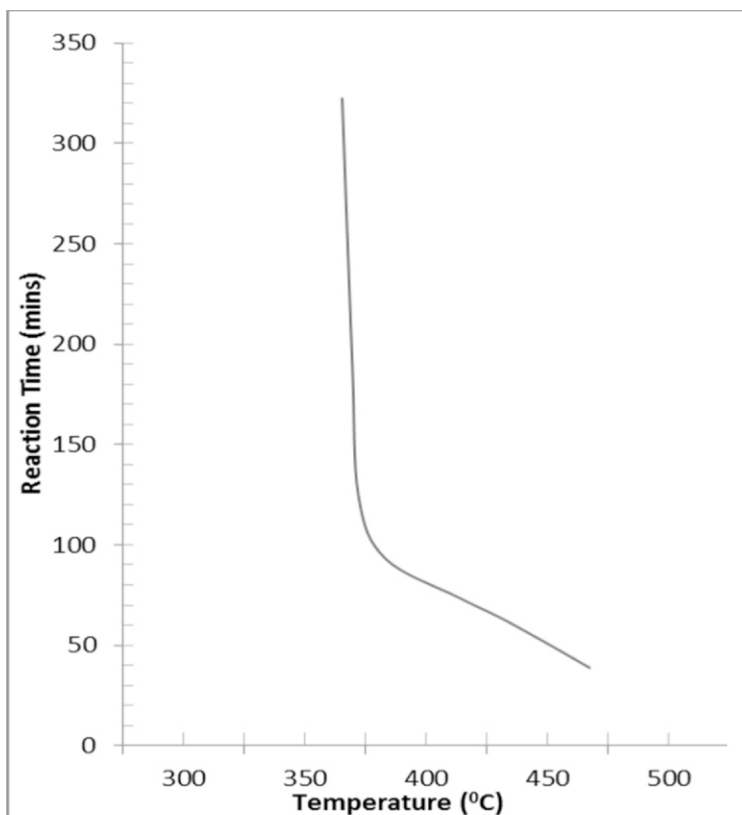
**Fig. 5:** Reaction Time vs Temperature (Pt/Al_2O_3).

Fig5 shows the duration of reaction cycles at various temperatures (Omoleye, J A., Susu, A. A. 1990). As the temperature of reaction was decreased from $470^{\circ}C$, the duration of reaction cycle of fresh catalyst increased steadily.

However, as the temperature was reduced to around $370^{\circ}C$, there was a sharp increase in the cycle reaction time. A reaction carried out at $300^{\circ}C$ was abnormally long such that the reaction had to be stopped after 500mins.

Fig.6, 7 show the detailed profile of each cycle at various temperatures of reaction. Note the wide margin In the relative cycle lives at 370°C and 394°C on Fig7 .
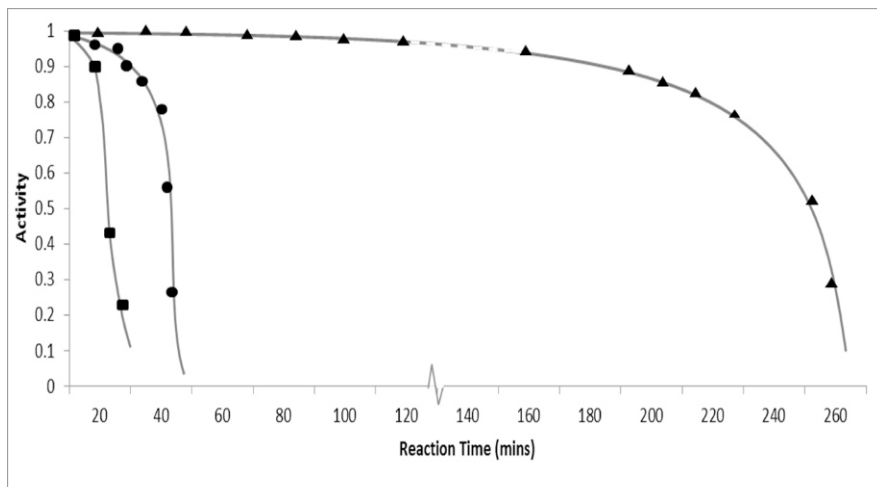

**Fig. 6:** Pt - Re/Al$_2$O$_3$ Catalyst Deactivation Profile at Various Temperatures.
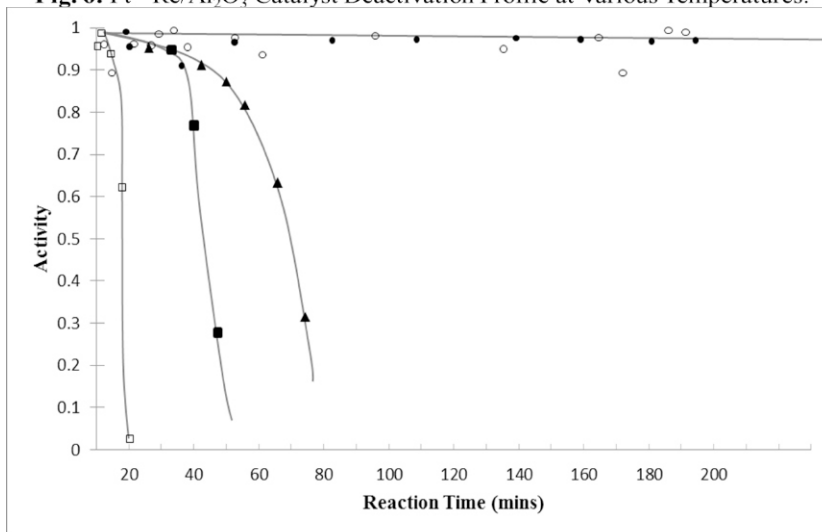
Fig. 7: Pt /Al$_2$O$_3$ Catalyst Deactivation Profile at Various Temperatures.

(e) The effect of temperature on the cycle life is best understood from Fig 9. The graph shows that the level of primary coke formed on the active surface of the catalyst increases as temperature of reaction increases; thus promoting the formation of both the secondary and tertiary fouling coke responsible for the deactivation and hence the mortality of the catalyst.
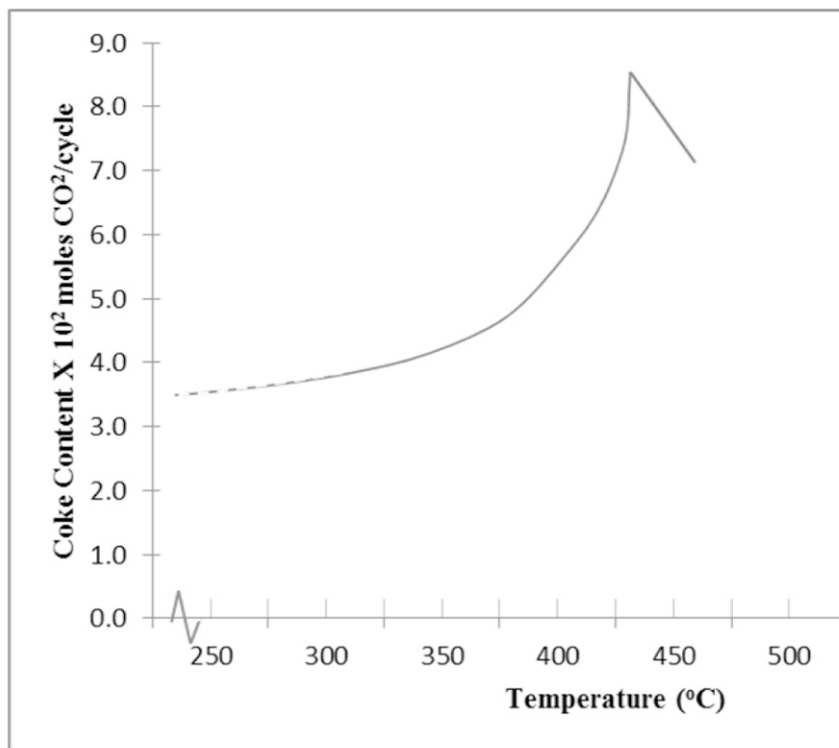
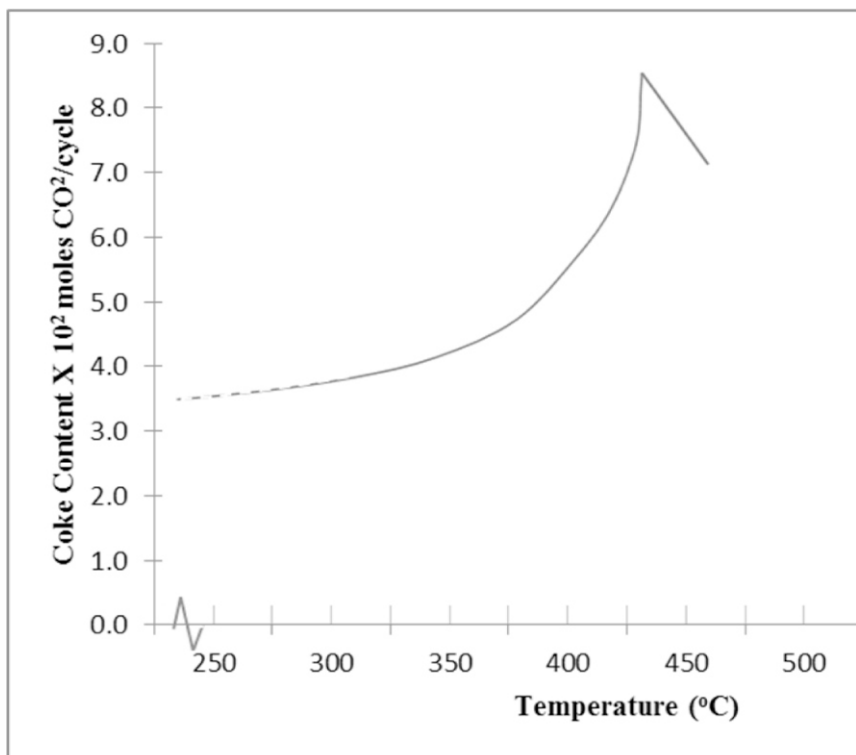**Fig. 9:** Coke Content vs Temperature.

(f) Fig 8 shows the level of conversions to benzene at various temperatures superimposed on the cycle lives at those temperatures. There is an optimum temperature of about $430^\circ C$ at which maximum
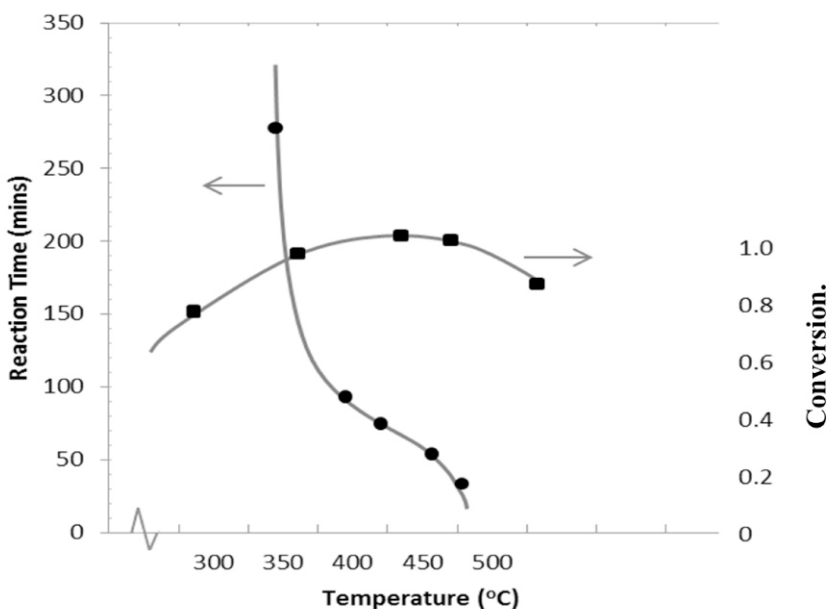
Fig. 8: Reaction Time, Conversion vs Temperature.

conversion to benzene is achieved; however, this will be at the expense of such a short cycle life that may not be economic. Operating at a temperature below 370°C offers such a very long cycle life that outweighs the slight decrease in conversion at that temperature.

One of the major discoveries of this work is the identification of the temperature below which the cycle life of Platinum Alumina catalyst is greatly prolonged. This will drastically elongate the life span of the catalyst and thus reduce the operational cost of the Refineries.

Fig. 9: Coke Content vs Temperature.

CAUSE OF DEACTIVATION AND MORTALITY

Proffering solution to the deactivation and possibly the mortality of Pt/Al_2O_3 catalyst may be an impossible task without a good understanding of the cause(s) of such deactivation. Previous literatures (Agrawal, et al, 1980) queried the possibility of an electronic effect on the kinetics of the main reaction by the coke deposited on the active site of the catalyst rather than a mare coverage making them unavailable for reaction.

Table 1 shows the trend of deposition of the primary coke and the equivalent level of activity of the catalyst as the reaction progresses at $300^{\circ}C$.

Table 1: Coke Contents and Activities with Time of Reaction (300°C)

Time (min)	45	160	240	270	430
Coke (mole CO_2)	0.0245	0.0253	0.0345	0.0325	0.0345
% of total Deposit	71	73	100	95	100
% of full Activity	97	88	87	85	77

After 240minutes of reaction, all the primary cokes had been deposited on the catalyst but the catalyst was still 87% active. This raises doubt of whether the primary coke is really responsible for the catalyst deactivation. Moreover, at zero further deposition of primary coke after 240 minutes the steady decline in the activity of the catalyst still continued, falling to 77% at 430minutes of reaction. This clearly shows that the substance responsible for the deactivation of the catalyst and hence the mortality is most likely not the primary coke but likely a secondary coke getting formed from the already deposited primary coke according to the chain coking reaction model proposed by Corrella and Asua (Corrella, J. and Asua, J M., 1982)

Table2 shows the value of the rate of reaction constant, k and the adsorption coefficient, k_A at the beginning and at the middle of the reaction at 370°C.

Fig.2: Change in the Values of k and K_A in the Cause of the Reaction (370°C

	Beginning of Reaction	Middle of Reaction
Rate Const. k (kmole/kg.hr)	0.119	0.05
Adsorption Const. k_A (l/mole)	171	315

There was a decline in the rate of reaction as reaction progressed: rate constant decreased and less reactants got adsorbed. But most importantly, the change in the values of the rate and the adsorption constants in the course of the reaction is a clear indication of a change in the kinetics of the reaction. This is a confirmation that the deactivation of the catalyst and hence the mortality of Pt/Al_2O_3 catalyst is not directly as a result of the coverage of the active sites by the primary Coke but as a result of the electronic effect of some secondary deposited coke on the kinetics of the main reaction occurring on the surface of the catalyst.

PROPRIETARY REACTIVATION PROCESS

The normal reactivation procedures, through the oxidation of the Coke, followed by the reduction of the oxidized active sites, were successful in removing the secondary Coke formed from cycle to cycle. However, this process failed to reactivate the catalyst at the mortal state. Normally, it is at this stage The Refinery discard the old batch of catalyst for a new one. In the course of this work we succeeded in devising a new reactivation process that revived the mortal catalyst suitable for some further number of cycles of reaction. Fig. 4 shows the catalyst at its mortal state on cycles 23 and 24. The application of our proprietary reactivation process shows the catalyst at its reviving states at cycles 25 and 26. The values of the cokes recovered from its active surfaces are close to those at the adolescent age of the fresh catalyst. The worth of the catalyst after the 26th cycle (revived state) is greatly higher than at the mortal state if returned to the manufacturer for a rebate.

SOME SIGNIFICANT OBSERVATIONS

(1) Platinum Alumina Catalyst replicates human Life

-Platinum Alumina replicates three-stage human life of Infancy, Adolescence and Adulthood

- As air and specifically Oxygen is indispensible to human life, so it is for the life platinum Alumina catalyst in use.

- As human metabolic enzymatic reaction produces toxic waste so also Pt/Al_2O_3 catalytic dehydrogenation of Cyclohexane produces toxic side product

- Just as human body has a routine mechanism for eliminating toxic waste so also Pt/Al_2O_3 catalyst has a routine waste removal process.

-As renal failure causes accumulation of toxic waste of Urea that leads to unconsciousness and subsequently death so also failure to remove accumulated toxic tertiary Coke leads to a state of inactivity and mortality.

(2) The likely formation of Chains of Toxic Wastes in the Human Body

Past investigations revealed the direct effect of coke formation on the cycle life of Pt/Al_2O_3. It was however not clear if it is simply through the physical covering of the active sites of the catalyst or through electronic effect on the mechanism of reaction. It was also not clear if the only type of coke formed is the primary one or along with the secondary, tertiary, etc formed in the chain of coking reaction.

This work has confirmed, through the computational analysis of the experimental data that both the secondary and tertiary cokes are formed along with the primary (may be at different rates and stages however). This work also shows that the secondary and tertiary cokes are responsible for the catalyst deactivation and mortality respectively. While the primary and secondary cokes are removable through the

regular reactivation processes, the tertiary coke that is responsible for the Catalyst mortality is only removable through the proprietary process developed in the course of this work.

This fact however raises a major question:

Taking into consideration the fact that Pt/Al_2O_3 catalyst replicates human life as seen in (1) above, one wonders if there are no other toxic by-products of our metabolic process that are not removable through the natural body waste discharge processes, that are responsible for accelerated body cells aging and subsequently varied accelerated death, depending on their rates of formation and accumulation in individual's body? What physical contribution did a man by name Methusela make to enable him live for 969years (Gen.5:27) and what physical contribution do we make today leading to a life expectancy of 65years?

(3) Hot Food and inferred Effects

Fig.(5) of this work, shows clearly the life-shortening effect of high temperature of reaction on Pt/Al_2O_3 catalyst. Fig (9) also shows that the higher the temperature of reaction, the higher the quantity of toxic coke formed on the catalyst.

The enzymatic metabolic reaction in the body just like the catalytic one described above, from reaction kinetics, responds in like manner to temperature.

These facts raise a question of what effect a habitual high temperature food preparation and hot food consumption may have on the formation of toxic waste products and hence on the health of man. From the general principle of reaction kinetics, high temperature will lead to a high rate of metabolic reaction. While higher rate of production does not necessarily lead to a higher yield of the desired or undesired products, it has a possibility of resulting into an increase in the yield of toxic waste in the body, if such higher temperature favors

the selectivity of the toxic wastes.

(4) Existence of a Temperature for healthy Food Preparation and Consumption?

The existence of a temperature between 370 and $380^{o}C$ below which the Pt/Al_2O_3 catalyst cycle life is highly prolonged is established in this study (fig.8). Beyond this temperature i.e. from around 390oC and above, the catalyst cycle life suffers a steady decline with increase in temperature up to about $470^{o}C$ beyond which there is no meaningful conversion to the desired product.

While the cycle life of the catalyst experiences a rapid and great increase in cycle life below $380^{o}C$, there is an accompanying steady decrease in the reaction conversion as temperature of reaction decreases from $430^{o}C$ to $300^{o}C$. There is therefore an optimum temperature for the main reaction on Pt/Al_2O_3.

This again raises the question of whether there is an optimum temperature at which the enzymatic metabolic reaction has the lowest selectivity for toxic food waste products. From another angle, is there a temperature beyond which food preparation enhances the formation of some toxic waste that has the potential of shortening life?

What low temperature of food preparation and consumption will help us avoid the formation of toxins without compromising the level of digestion to useful body nutrients? Without sounding dogmatic, one can reasonably infer that the thermostatic human body temperature of $37.8^{o}C$ has been purposely designed by the Creator as the optimum temperature for good health.

There is a need to investigate if this body temperature is the safest one for daily food consumption – this is without prejudice to the ability of human body to regulate the temperature of some of the consumed food to this optimum temperature before digestion.

(5)   Introduction of toxic waste Cleansing Food Supplements

The normal periodic catalyst reactivation process through the use of air fails to remove the resistant tertiary toxic coke formed. This is most likely responsible for the mortality of the catalyst.

God has perfected His design of human body with respect to the elimination of the toxic waste, ie. Urea is eliminated through urination. However, man has advanced (positively or negatively) through the introduction of compound food prepared and consumed at high temperatures.

 We have also gone electronic with the introduction of micro-wave usage in food preparation and preservation. These have taken us far away from inception when man ate fresh fruit and vegetables, all at ambient temperature that is close to normal human body temperature, especially at the blessed tropical region of the world.

This is probably one of the major reasons for the better health claimed by vegetarians. Incidentally, I am not one.

The onus is therefore on man to determine any extraneous toxic waste product formed in the body as a result of newly introduced food preparation techniques and also introduce appropriate toxic waste cleansing supplement(s) to such daily diet. This may be a step in the right direction to living long like men of old who lived between 180 and 969years. (Gen.5:1-32)

CONCLUSION

This work has revealed some similarities in the lives of Pt/Al_2O_3 Catalyst and human beings. This similarities therefore gave us the platform to wander if the effects of resistant toxic wastes formed on the catalyst surface and the high level of its formation at certain high temperature leading to its mortality, can give us more insight to the cause(s) of reduction of life expectancy of man on earth, and what can be done.

This investigation has highlighted a number of queries and ideas that

need confirmation through further studies. Even though the human body has a thermostatic temperature moderation mechanism, a metabolic food digestion temperature at one degree or two above the optimum, from kinetics of reaction, is high enough for a health challenge through the formation of toxins. We shall be ready to collaborate with reputable health Institutes/Personnel in investigative studies of the ideas raised in this presentation.

This presentation shall not be complete if it is limited to physical healthy Body cleansing process alone, without recognizing the fact that man is made up of body, soul and spirit, and that the spirit of man has a great influence on his physical health.

A healthy mind is prerequisite to a healthy body. A healthy mind however is a product of a healthy Spirit. The only cleansing tonic for the regeneration of the defiled and thus unhealthy Soul and Spirit of man is the Blood of Jesus.(1Jhn1:7, 1Pet2:24)

A combination of "clean" body and Spirit are criteria for healthy living, up to the divinely ordained full age of man on earth and for an unbroken eternal relationship with God.

RECOMMENDATION

A few findings that will be found useful by some relevant Industries specifically and the society in general have surfaced in this work and presentation.

Refinery and Petrochemical Industries

- (a) An optimum Temperature for efficient performance of the Pt/Al_2O_3 Catalyst in reforming reactions has been identified. The application of this temperature in the Refinery promises to extend the life span of the catalyst tremendously and reduce the operational cost of the Industry.
- (b) The proprietary reactivation procedure developed in the course of this work, covered by patency, will prolong the life of the

catalyst at the desired conversion level and save money.

- (C) Nigerian Refineries will earn more money from their spent catalyst, if they treat them with our recovery process before sending them to the manufacturer for a rebate

World Health organization (WHO) and National Health Ministry

- The health issues raised here: the suspected production of extraneous metabolic toxic waste produced in the modern day food processing techniques and retained in the body detrimental to good health needs further investigation for confirmation. WHO is invited to partner with us and other reputable health Institutes for this investigation.

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