

DECLARATION

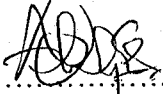
This is to certify that i Afoloyan Toba with, matriculation number 2003/14931EH did this research work myself and with the help of my supervisor. It is an original idea that I got during my first degree formation as a chemical engineering and it has not been presented in any form or any organization or institution for the purpose of degree. All sources of information have been acknowledged.

Toba Afoloyan

20/11/2008

CERTIFICATION

This project work has been read and approved by the undersigned, as meeting the requirement of the department of chemical engineering, Federal University Of Technology, Minna .



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10-11-2008
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signature & Date

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External Examiner

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signature & Date

DEDICATION

I am dedicating this project to my late friends and late cousin Aodu David babamini ,Kabiru Tijani and Soji Onipede

ACKNOWLEDGEMENT

My special note of acknowledgement goes to God Almighty for giving me life and strength to see this and witness such a great experience in my life. He also made way for me where it seems to be no way.

I am indebted to a number of people who helped me in one way or the other to make my degree program see the light of day. I always thanks my Parents, my Brother, my Sisters and the whole extended family for their tireless support put together for my success, I will also like to appreciate my Uncle Prof. Odetunde, Dr Otunola Adeyemi Labio and Tunji Duntoye for their Gigantic moral and financial support. I will continue to appreciate the family of Mr. and Mrs. Balogun for the complete support of my University Education. I also acknowledge the family of Chief Agba Akin of Oro land, Cecilia Binuyo and their Children (Father Akin, Jumoke, funke rouke and Yetunde Mama). I will not forget the Family of my late friend Karbir Tijani and his daughter.

Never will I forget the family of Mr. and Mrs. Olatunji for a complete moral and financial support. Infact I don't know how to appreciate this family.

Mama babby and her Husband will never be forgotten for once, for the role they have played in my academic life. My friend Oluwole Dosunmu, Babamini (David), Bolaji Atolagbe, Rosaq (Rosco), Christian Obeyka, Ifedapo Ogungbemi, Leonard Akpaniwo, and somany others, are highly appreciated.

Mrs. L.A. Afolayan is not only my mother but also my good friend. I acknowledge all her effort over my life.

My Father Engr, J. O. Afolayan retired, his highly acknowledge for his running up and down for the success of my academic and the family as a whole.

I am using this opportunity to acknowledge my elder brother Mr Ademola Afolayan, my sister Mrs. Tosin Dada and mrs Toyosi Olorunishola for their love moral and financial support.

I will like to close this acknowledgement by giving special thanks to people that make this research work to be possible.

Firstly, I acknowledge the effort of my able supervisor Engineer M. A. Olutoye for guiding me throughout my project work. I also appreciate Ejiro for her gigantic moral support. I also acknowledge Mr. Yahama Audu of department of Animal production F.U.T Minna for his kindness and assistance render during the project experiment.

And finally to myself, a great Kudos for the courage in the course of this program and that of the project.

ABSTRACT

This project is centered on the development of acidify clay catalyst to degrade polypropylene at high temperature which yield three different products at the end of the experiment. The products were solid residue [black coal], liquid fuel, and gaseous fuel. The liquid sample obtained was taken for a gas chromatography analysis. Which show the present of waxy oil and hydrocarbon of fraction nC5-nC15 compound equivalent to hydrocarbons with boiling point over 36°C-270°C and 50°C- 20°C, which is equivalent to paraffin and gasoline.

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CHAPTER ONE

1.0 INTRODUCTION

A degradation of polymeric material is an important issue from both the academic and the industrial view Point. Understanding the degradation of polymers is of paramount important for developing a rational technology of polymer processing and higher temperature application.

Controlling the degradation requires understanding of much different phenomenal including chemical mechanism, the influence of polymer morphology complexities of oxidation chemistry and the effect of stabilizer fillers and other additive. Polymeric materials are clearly the fastest growing packaging made material .The Sharpe increase in the level of production and consumption of polymeric materials as actually reflected in the large quantity of the waste being generated in the urban areas. The basic environmental concern about polymeric materials is in regards to the hazards which they pose at a point in their live after they are discarded. They can generally lead to the discarding of solid waste in form of municipal trash our major complaints are cantered on their role in littering the environment most plastic do not degrade and so they take up an excess volume of space in land field.

package water waste or P.P comprises a reason percentage of road side with its management has continue to pose great challenges to environmental engineer because of the striking increase in consumption of package water waste all over the environment. These waste are discarded serious environmental nuisance for instance, the increasing rate of flooding in our cities today cause by blockage of drainages system by these waste and by the unsightly street/road side litter are of great concern to the public.

The pollutant from the combustion of oil/coal and some waste which are biodegraded able are still present problems but now, advances in science promise to clear up these trouble spot. This research work is investigating of these pollutants mostly made from waste plastic or P.P material. Polypropylene is a plastic and a versatile polymer of a chemical designation C_3H_6 prepared from propylene (I.U.P.C name propane), it serves dual purpose both as plastic and also as a fiber. As a plastic ,it is used in making things like dishwasher, safe food containers, handles for pot, pans and currency note etc. this light weight high melting points makes it well suitable for this purpose (A.P.M.E./1999)

Most commercial P.P has an intermediate level of crystalline between that of low density polyethylene (L.D.P.E) and high density polyethylene (H.D.D.P),it is less flexible than polymer than L.D.P.E, its is much less than brittle than H.D.P.E, this allows polypropylene to be used as ABS .polypropylene is ragged often some what stiffer than some other plastics ,reasonably economical and can be made translucent as polystyrene

,acyclic or certain other plastic can be made.

Plastic materials play an important role in human life in the modern society. It has been noted that its total plastic consumption was 150mt in 2000 worldwide and only in Europe 45mt, which will reach 35mt in 2010; as reported by A.P.M.E summary report on analysis of plastics and recovery in Western Europe 1999. The utilization of technology in the world. In Nigeria plastic are principally disposed of by incineration and by land filling both methods have several problems, land filled plastics will not degrade: end gases with high content of toxic and harmful compounds, can be arisen in case of incineration, which will require special filter system with high efficiency which will only decrease their concentration but not eliminate, leading to environmental problem

Recycling has been advocated as an alternative method for waste plastic disposal. Another solution to the increasing accumulation of waste plastic is to catalytically degrade plastic into fuel oils, under controlled temperature and reduction conditions. Plastic can degrade randomly into short chain hydrocarbons with different carbon number. The main chemical reaction is the thermal (non catalytic) and catalytic cracking methods. After chemical treatment of the waste polymer to breakdown long alkyl chain into mixture of higher hydrocarbons. The hydrocarbon mixture having high olefin content can be saturated with hydrogen and perhaps isomerizes by the use of catalyst cracking reactions are endothermic and need energy the required heat and temperatures can be reduced with catalytic. Also product distribution can be controlled using catalysts. Also product distribution can be controlled using catalysts. Also product distribution can be controlled using catalysts.

There have been many reports on the catalytic degradation of plastic over solid acid catalyst purpose at converting waste plastic most favored catalyst used were the zeolites which although increase the yield of the volatile products and give rise to summarization, its application in cracking reactions are however too expensive and the treatment of the wastes would become expensive well, that is why this research work is aimed at using an acid treated clay as an alternative catalyst for the degradation of polypropylene to reduce the cost of degradation.

1.1 AIM AND OBJECTIVES

Knowing that plastic wastes can be recycled, treated and used as raw materials was decided to investigate into the possible ways of the handling these wastes, with the view of utilizing it and hence reduce the large volume of waste and the extent of litter experienced on our street. The environment hazard by the wastes will also reduce and

create employment opportunities.

Clay which is readily available and cheap is use as an attractive for expensively manufactured catalyst can be use in plastic recycling.

To show that waste plastic could be converted to more useful materials.

To create a substitute and also increase the availability of fuel

To summarize recent development in the study to then thermal and catalytic degradation of polypropylene

1.2 SCOPE OF WORK

The scope of this research work is to investigate the catalytic degradation of polypropylene at high temperature.

1.3 LIMITATION OF STUDY

Part of the limitation or the difficulties in processing plastic wastes is in its diversity. Plastic wastes encompass a wide range of materials with differing properties and chemical composition due to different types of plastic materials. This hinders the application of an integrated and general approach in handling this plastic waste. The light weight of plastic goods, and the fact the plastic materials are on mainly found in municipal solid waste mixed with other classes of residues are factors that generally limit their recycling. These difficulties are responsible for the preferred dumping of plastic waste in land fill sites where they remain for decades due to their slow degradation rate. As land fill space become increasingly scarce municipalities across the world are looking for recycling alternatives for many of their solid waste materials of which a reasonable proportion are plastic

1.4 JUSTIFICATION OF RESEARCH WORK

The degradation of low density polypropylene yield liquid, solid and gaseous products of high temperature. The yield of the products in three different states is attributable to the extent of cracking, while complete decomposition is favored by high temperature. The process is environmental friendly and result into availability or substitute of fuel in the society and world at large.

CHAPTER TWO

2.0 HISTORICAL DEVELOPMENT OF POLYMER (POLYPROPYLENE)

Polymer is a word which comes from two Greek words, where poly means, many and 'Mer' means, part (units), i.e. many small part or unit combined to form a compound.

Before 1868, nothing was talked about polymers. In 1868, John Wesley Hyatt produced cellulose nitrate (Nitrocellulose) by mixing pyroxylinates with nitric acid and camphor to get something looking like billiard balls.

Nothing again was talked about polymer until 1909 when Dr. Leo Hendricks Baekeland mixed phenol and formaldehyde to produce phenolics or bakelite. These (phenolics) are polymers that are used in making electrical fittings and adhesive. After these polymer (Nitrocellulose and phenol formaldehyde) followed such as cellulose acetate which are used for the production of tooth brush and cutlery. Urea formaldehyde which are used for production of bottoms, electrical accessories, adhesives foams (packaging foams) etc. Polyvinyl chloride which are used for the production of surgical equipment etc.

In 1920s people were interested in the chemical composition of the polymer but water people became more interested in their structural composition. Two people were responsible for the latter development. German Chemist Herman Staudinger who works on rubber i.e. poly (polyethylene). He was the first to indicate that polymer is composed of giant molecules of macromolecules. Also American Chemist -W.J. Carothers who works on nylons. In his study of nylon which he produced in the process of reacting carboxylic acid with diamines classified polymer as either condensation or addition polymer. A very good example is polystyrene and polyethylene as addition polymer. These were the innovation of the 2nd world war, and were used as insulating materials.

Polypropylene is a polymeric material which was first polymerized by Dr. Karl Rehn at Hoechst AG in Germany. In 1954, who didn't recognize the importance of his discovery. It was then rediscovered on March 11 1954 by Giulio Natta. At first it was thought that it would be cheaper than polyethylene. At about the same time Philip Petroleum of the Netherlands, Paul Hogan and Robert Bank who are working together were credited as the official investor of the material. This was after polypropylene manages to survive legal process.

Polypropylene is similar to survive legal process is similar to its ancestor polyethylene and share polyethylene low cost but it is much more robust used in very thing from plastic bottle to carpets plastic furniture and is heavily used in automobiles been a product of polymerization product of propylene (propane)

The American society of plastic industry developed a standard code used in place other than united status as well. This makes the identification of the plastic type to be

2.1 TYPE OF POLYPROPYLENE

- (a) LOW DENSITY POLYPROPYLENE (LDPP)
- (b) HIGH DENSITY POLYPROPYLENE (HDPP)

CHEMICAL AND PHYSICAL PROPERTIES OF POLYPROPYLENE

Most commercial polypropylene isotactic and has an intermediate level of crystalline between that of low density polyethylene (LDPE) and high density polyethylene (HDPE); its young's modulus is also intermediate. Though the incorporation of rubber particles, PP can be made both tough and flexible even at low temperatures. This allows polypropylene (one to be used as a replacement for engineering plastics, such as ABS. Polypropylene is rugged, often somewhat suffer than some other plastics reasonably economical, and can be made translucent when a colored but is not as readily made transparent as polystyrene, acrylic or cretin other plastics. It can also be made opaque and/or have many kinds of colors through the use of pigments. Polypropylene has very good resistance to fatigue, so that most plastic living hinges. Such as those on flip top bottles, are made from this material. Very thin sheets of polypropylene are used as a dielectric within certain high performance pulse and low loss RF capacitor.

Polypropylene has a melting point of 1... (320f), as determined by differential scanning calorimetry, melting use can be made from polypropylene because it can withstand the heat in an autoclave. Food containers made from it will not melt in the dishwashers, and do not melt during industrial hot filling processes. For this reason, most plastic tubs dairy products are polypropylene sealed with aluminum foil (both heat resistant materials). After the product has cooled, the tubs are often given lids made of less heat resistant material, such as LDPE or polystyrene. Such containers provide a good hand on example of the difference in modulus, since the rubbery (softer, more flexible) feeling of LDPE with respect to PP of the same thickness is readily apparent. Rugged, translucent, reusable plastic containers made in a wide variety of shapes and sizes for consumer from various companies such as Rubbermaid and Sterilite are commonly made of somewhat more flexible LDPE so they can snap onto the container to close it. Polypropylene can also be made into disposable bottles to contain liquid powdered or similar consumer products, although HDPE and polyethylene terephthalate are commonly also used to make bottles, plastics, nails, car batteries, waste basket, cooler containers, dishes and pitchers are often made of polypropylene or HDPE both of which commonly have rather similar appearance feel and properties at ambient temperature.

The MFR (melt flow rate) or MFL (melt flow index) is an indication of pp molecular height. This help to determine how easily the melted raw material will flow during processing Higher MFR pps fill the plastic mold more easily during the injection or molding production process. As the melt flow increases, however, some physical properties like impact strength will decrease.

There are three general types of pp. homopolymer random copolymer and impact or block copolymer. The common used is typically ethylene. Ethylene propylene rubber added to pp homopolymer increase polymerized ethylene monomer added to pp home polymer decreases the polymer crystalline and makes the polymer more transparent.

USES OF POLYPROPYLENE

Polypropylene is used in a wide variety of application including packaging, textiles(e.g. ropes, thermal underwear and carpets),stationary, plastic parts and reusable containers various types, laboratory equipment, loudspeakers, automotive components and polymer banknotes an addition polymer made from the monomer propylene it is rugged and unusually resistant to many chemical solvent bases and acids. it can also be use in making handle of pot.

CLAY

Clay are formed as a result of weathering process and as a consequence, are found in the most soils. clay belong to the group of silicate minerals with sheet structure which have as their basic building unit, polymerized sheet silica tetrahedral in which three or four oxygen molecules are shared.

The essential composition of clay are silicon, water and aluminum and appreciable quantities of ion, alkalis, and alkaline earths are frequently present, small amount of amorphous materials like quartz, mica and iron oxide may also be present.

USES OF CLAY

- (1) Clay has the ability to separate colors from oil.
- (2) Clay are used as bonding agent in casting of metals.
- (3) It is used in a catalyst preparation which speeds up the rate of production of gasoline in the gas oil industries.
- (4) It is used in building house.
- (5) Clay can be used as a source of aluminum, silica, iron alkalis, and alkaline earth.
- (6)Clay are used in paper industries for paper coating.

PYROLYSIS OF POLYPROPYLENE

Pyrolysis is the destructive distillation which is carried out in the absence of air by the application of indirect heat. Waste trash can be converted into usable fuel, or modified to produce ash, slag and ferrous metals from solid, or in chemical plants, most are liquid residue. The gaseous product generated may be useful as fuel or be consumed. Pyrolysis is one of the several methods suggested by some experts in the field of engineering for so long the problem of waste plastics. It involves chemical treatment where long alkaline chain and broken into a higher mixture of hydrocarbons have not been solved yet. One possibility of their utilization is fuel like application or blending in fuel or mixing component, many research study their application as fuel. This hydrocarbon mixture having high content can be saturated with hydrogen and perhaps isomerizes by the use of catalyst. Cracking reaction are endothermic, the heat and the temperature can be reduced with catalyst, but the disposal and the activation loss or regeneration of the catalyst could cause some problem to the system.

The acid treated clay (catalyst) used in thermal degradation of the polypropylene materials is used in converting polypropylene products into useful hydrocarbon.

THERMAL DEGRADATION

Thermal degradation of polymeric materials is an important issue from both the academic and the industrial viewpoints understanding the thermal degradation of polymer is of paramount importance for developing a rational technology of polymer processing and higher temperature application controlling degradation require understanding of many different phenomena, including chemical mechanism, the influence of polymer morphology, the complexities of oxidation chemistry. and the effect of stabilizer filler and other additives.

The investigation carried out by several researchers investigated the thermal recycling of waste polymer under different operating conditions. The dynamic thermal degradation of high density polyethylene to 650°C as carried out at the University of Verszprem, department of hydrocarbon and coal processing yielded n-alkenes, alk-1-ene and a v-deice in the range C₄-C₂₀. Higher, molecular weight of species C₂₀ was not detected and there was no evidence of branched alkenes in any region of the gas chromatogram.

Higher temperature was also reported of gas and coke yield are higher and the liquid fraction has significant aromatic and cyclic hydrocarbon content. It is well known that the thermal degradation of polyolefin polymers occurs by the random scissoring of the long polymeric chain and the products of molecular weight. Therefore amount of total unsaturated per gram of liquid product for thermal degradation also, the

thermal degradation of polymers takes place by radical mechanism and result mainly in monomers and oligomers.

VARIABLES IN CATALYTIC DEGRADATION

The major variable in catalytic degradation are :

1. Resident time of the product
2. Temperature
3. Nature of catalyst

EFFECT OF RESIDENT TIME

Catalyst degradation can be varied by changing the amount of catalyst in unit time, which describe the resident time. In keeping with the change in conversion of gaseous product increase in the first Moment of degradation time increase the yield of liquid.

EFFECT OF TEMPERATURE

Degradation and product distribution are highly affected by reaction temperature. At higher temperature, liquid product are formed that at lower temperature which favor the product yield of gases. From this analysis it can have concluded that the degradation increase with increasing temperature.

EFFET OF CATAYST

Catalyst speed up the rate of reaction but not been consumed . The amount of catalyst used to contact a given amount of oil is an important variable in catalytic cracking. In cracking, the catalyst in rapidly changed, by the growth f coke deposit. this change decrease the amount of catalyst produce higher liquid yields at the some time.

CATALYST

An ideal catalyst will increase in speed of a reaction without itself being destroyed during the reaction.

In industry time means money and the speed with which reaction take place is of great importance. For example if one company can make a drug faster than the another, that company has a greater chance of making a profit on its sales.

Catalyst are widely use to accelerate the rate of a chemical reaction by lowering the activation energy, In catalyzed reaction the basic law of chemistry and thermodynamics are observed and the pressure of catalyst greatly influence the chemical reaction although the catalyst remains unchanged at the end of the reaction.

Montmorelonites is a naturally occurring which was first employed industrially these were gradually supervised by synthetic clays. The amorphous silica-alumina which in turn have largely replaced by the synthetic zeolite.

CHAPTER THREE

3.0 SOURCE OF CLAY

The source of clay used for the degradation is clay from termite hill in Chanchaga local Government area in Minna, Niger state. In order to carry out the catalytic degradation of polypropylene using acid treated clay as catalyst aimed at converting waste polypropylene product into liquid, solid and gaseous hydrocarbons. The following apparatus are used in the experimental process. The process adopted in this study was the direct mixing of the polymer and the acidified clay at a specified ratio before charging the field into the catalytic reaction for the degradation process.

APPARATUS/EQUIPMENT

1. Glass tube reactor (made by Pyrex material) can withstand temperature above 800c
2. Gas Chromatography
3. U -Tube glass rod
4. Beakers
5. Glass Funnel
6. Petroleum ether
7. Thermo - couple
9. Measuring Tube
10. Hot Plate magnetic stirrer
11. Polypropylene material
12. Clay (red clay)
14. Oil m H_2SO_4
15. Sample bottles
16. Nitrogen gas
17. Polyethylene bags
18. Veneer caliper
19. Filter paper Electronic weighing machine
20. Oven
21. Furnace
22. Retort stand
23. Rubber pipe
24. Crucibles
25. Bromine solution
26. Lead (ii) trioxonitrate (v) solution
27. Acidified K_2MnO_7
28. Distilled water
29. Flow meter

30. Water bowl
31. Sieve
32. Pan
33. Conical flask
34. Steel rule

METHODOLOGY

PREPARATION OF 0.1M OF H₂SO₄

5.43 cm³ of H₂SO₄ was measured and diluted with H₂O into 250cm³ conical flask, when pour the 5.34cm³ of the H₂O (never pour water into acid). Add deionized distilled H₂O into the sample unit it get to 250 marks. That gives the 0.1M H₂SO₄

ACIDIFICATION OF CLAY

The particles size of the clay is firstly reduced by grinding it to powder form. then the sieve range fro 2800 um, 2000um, 710um and 250um were used and sample below 250um sieve diameter was collected in a pan. 50g , 100g ,150g , and 250g of the clay was measured, they are then mixed with water to form slurry, the water is then drained from the clay and placed in furnace for hrs at temperature of 600°C, the process which is know as calcinations of the clay

The powdered from is obtain by grinding the calcined clay.50g of the clay sample is weight and placed in a filter paper inside a funnel 0.1M H₂SO₄ is gradually poured into the funnel until 50ml of 0.1M H₂SO₄ was exhausted . Then the mixture is stirred with a motor stirrer for hours and the filtered by a vacuum filter, the excess acid is rinsed with water four me samples of the clay was prepared at a mass range of 100g with 100ml of 0.1M H₂SO₄. The sample are mixed and the mixture is dried in the oven for 12 hours at a temperature of 60°C, the acid treated clay which is then grinded to be in powered form is ready to be fed into the reactor as catalyst.

SOURCE OF POLYPROPYLENE MATERIALS

The source of the polypropylene is quite not too difficult because already used pure water sachets was used as the source of polypropylene made from (H.D.P.L).First the sachets are collected in mass 50g (0.5kg) which is sun dried to removed the water contained. The sachet is then shredded into tiny particles so that the reaction an take place faster.

REACTOR

The reactor that I used was made from pyrex and can withstand a temperature of up to 1000 °C. The whole process involves heat of a very great amount (400°C above), so

normal conical flask can not withstand such temperature.

THE DEGRADATION PROCESS

10g of the acidified clay is measured and recorded, then put into the reactor. The reactor was then placed on an electric hot plate and it was switched on, while the heat in the hot plate gradually rises with the catalyst already in it, the polypropylene material was also measured 30g and put into the reactor, while the reactor is closed, cause pyrolysis to take place in the absence of air, the delivery tube was connected to a sample bottle, one from the top and the other from the side, where one of the delivery tubes is connected in such a way that it is put into a water bowl which is filled with both water and ice, this is to serve as a condenser for the gas coming from the reactor to the sample bottle. A thermocouple wire is placed in contact with the reactor and the electric heater to measure the temperature of the system. The reaction is allowed to take for 40min before gas samples were started collected at an interval of 10minutes, the sample bottle which already contain 20ml of petroleum ether was placed at both ends of the delivery tube which is used to collect the gas sample like two gas sample is collected and sealed. The above process takes place at a temperature of 250c.

The solid residue from the first process was poured out from the reactor and polypropylene of 30g and the catalyst 15g was put into the reactor stirred and heat to a temperature of 800c for 50 minutes, when the reactor have stabilized for 60minutes, just as done earlier sample bottles containing ether was placed at both ends of the delivery tube and gas samples was collected at an interval of first minutes and other at 20 minutes.

Run by the ratio 2:1 and also 3:1 i.e. the polypropylene to the catalyst and various gas product was collected at various time interval at a temperature of 300c, the block residue is poured out of the reactor and polypropylene of 40g was measured and a catalyst of also 40g was measured which was both put and mixed in the reactor, the temperature this time was raised to 450c and the reactor lasted for 60 minutes before at one end an empty bottle without ether was used to collect the liquid product.

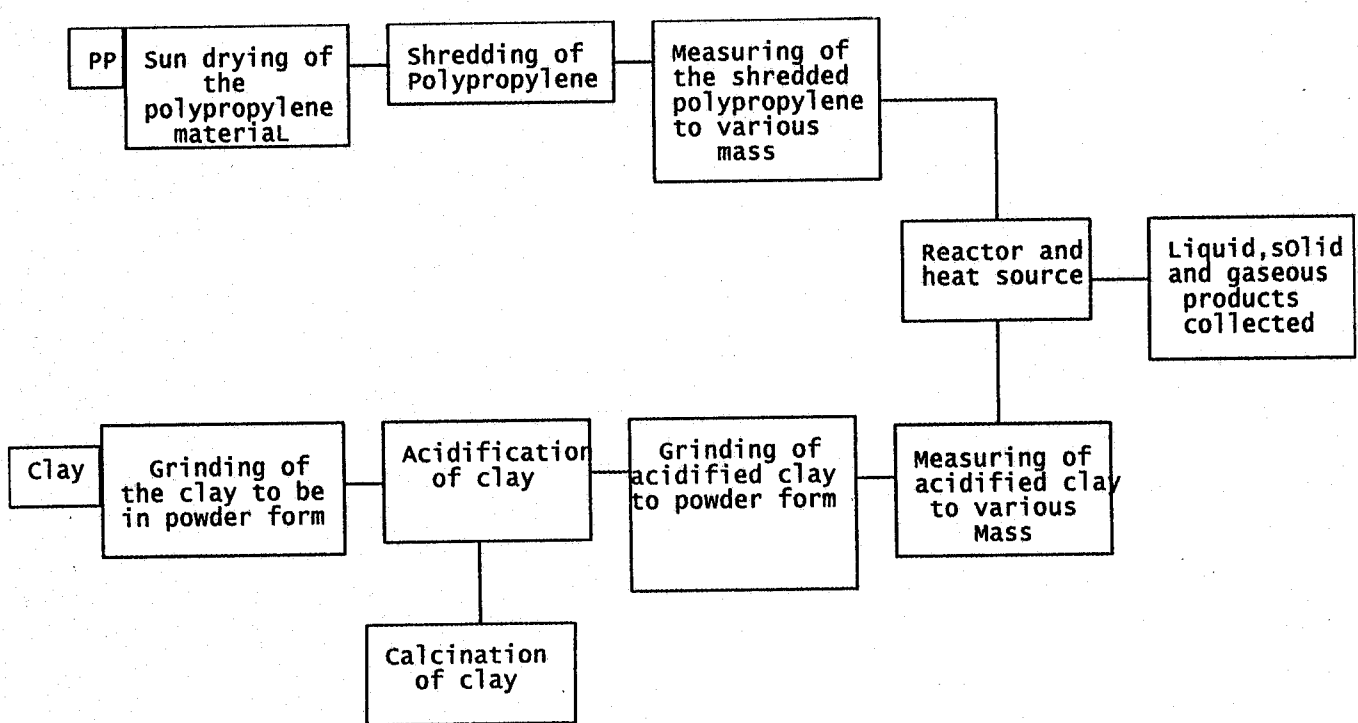
The entire gaseous product collected and the liquid sample was sealed and was taken for analysis.

ANALYSIS OF PRODUCT

The product obtained from the catalytic reaction process were analyzed using the following Methods and apparatus

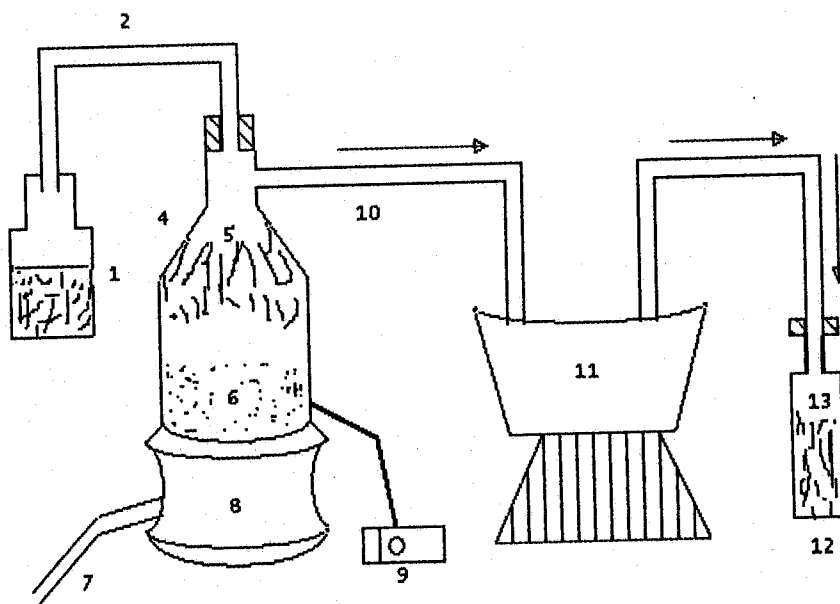
1. Iodine / Bromine number (I/Br) determine the degree of saturation of the liquid product.

2. Gas chromatography was used to analyze the gases that is present as well the olefin content.



PROCESS FLOW DIAGRAM OF POLYPROPYLENE DEGRADATION

EXPERIMENTAL SETUP OF POLYPROPYLENE

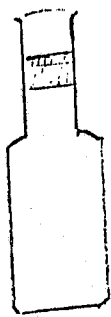


1. Sample bottle
2. Delivery Tube
3. cork
4. Catalytic reactor (Pyrex)
5. rising gas
6. mixed catalyst and polypropylene material
7. heat supply (source)
8. Electric heater with magnetic stirrer
9. Thermocouple
10. Delivery tube glass
11. Water bowl containing water and ice block
12. sample bottle
13. gas collected into other in sample bottle

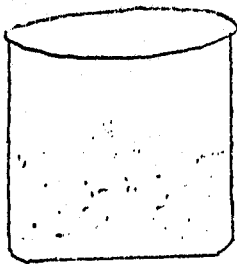
EXPERIMENTAL CONDITIONS

As it could be observed that it is possible to run the pyrolysis reaction with acid-treated clay catalyst at 300°C, pyrolysis products were obtained, the scale of experiments with this catalyst was expanded.

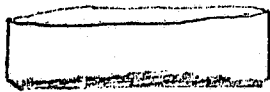
At the end, 6 experiments were carried out with clay as catalyst, this time the pyrolysis temperature scale began with 250°C as products still could be obtained at 300°C.



1



2



3

1. Sample bottle gaseous product collected into ether.
2. sample bottle containing liquid product.
3. solid residue.

CHAPTER FOUR

Results and Discussion of Result.

4.0 Results.

The analysis of the liquid sample gotten from the catalytic degradation of polypropylene was carried out using gas chromatography with the following:

- Agilent network GC system model 6890.
- Agilent mass selective detector model 5973.
- Starting temperature was 50 °C.
- Heating rate was 5 °C /min.
- Final temperature was 203 °C.
- Total running time was 40 minutes.

The chromatogram from the GC which shows the result of the analysis is giving in the appendix. The degradation of polypropylene in present of acidic clay catalyst gives solid, liquid and gas product.

4.1 Discussion of Result.

The following was obtained from gas chromatogram (result).

1. Whether or not the giving sample is pure.
2. Quantitative identification of individual component of a mixture.
3. Qualitative analysis of the mixture provided by the mixture.

The sample analyzed was not pure because it has different resident time 34.203 and 37.379 minutes for sample A and 34.203 and 37.379 minutes for sample B respectively this can be justified by literature of this project.

The qualitative analysis compared the retention time of unknown component with retention time of the standard that has been injected into the gas chromatograph. This can easily be explained for sample A by comparing figure Aii resident time (of unknown component) with that of the standard as shown in fig. Aiii using head to tail system of comparism. And after head to tail comparism at a time 34.203 minutes the chromatogram gives the structure of 7,8-epoxy lanostal-11-ol,3-acetoxy. Also at the resident time 37.379 minutes for sample A in fig Aii with that of the standard as shown in fig Aiii using head to tail system of comparism which gives the structure in fig Aiv.

For sample B, fig Biii compared fig Bii with the standard to give fig Biv with the structure of 2, 6-Dimethylheptane at the resident time of 34.203 minutes. At the resident

time of 37.379 minutes fig Biii compared fig Bii with the standard to give fig Biv the structure of Nonane.

From these analysis sample A clearly show that it is mixable with water and it is epoxy material ie waxy residue composed into higher liquid hydrocarbons over acidified clay catalyst. This analysis also show that for the catalytic degradation of polypropylene, liquid product where predominantly in the carbon fraction n-C5 to nC15 compound equivalent to hydrocarbon with boiling point over 36 °C to 270 °C (paraffin) and 50 °C to 205 °C for gasoline.

The pure component from the catalytic degradation of polypropylene can be achieved by fractional distillation. This is in agreement with the observation by Ugoha et;al that the pure component of product derived from the pyrolysis of polypropylene can be achieved by fractional distillation and compare with standard value.

The qualitative analysis is carried out on a particular component in a mixture by its retention time of a particular compound is constant for a fixed set of chromatograph conditions (flow rate temperature, column condition).

The area under each peak on the chromatogram is proportional to the concentration at the component in the original mixture. If the peaks are reasonably sharp and the fluid rate is carefully controlled, the peak or height is proportional to concentration. This calibration curve can be prepared by plotting either height or peak area as a function of concentration for a series of standard.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION.

5.0 Conclusion.

The degradation of polypropylene was carried out in presence of acid treated clay (catalyst) in a glass reactor which is made from Pyrex material, yield three products (solid, liquid, and gas).

The liquid product was analyzed using gas chromatograph which shows the presence of products having a boiling point ranging from 50 °C to 205 °C equivalent to boiling point of gasoline and boiling point of paraffin with n-C6-nC15, paraffin have their weight length in the range 200 – 800nm. This is immiscible with water with the presence of nonane and 2, 6 –Dimethylheptane. Also there is a presence of waxy oil [7, 8-epoxylanostan-11-ol, 3-acetoxy]

The catalytic degradation of polypropylene lowers the activation energy, reduce the energy consumption and improve the process efficiency. It also lowers the cracking temperature, increase the reaction rate and increase the production iso-alkane and aromatics.

G.C is very good for this analysis because it does not contain double bonds.

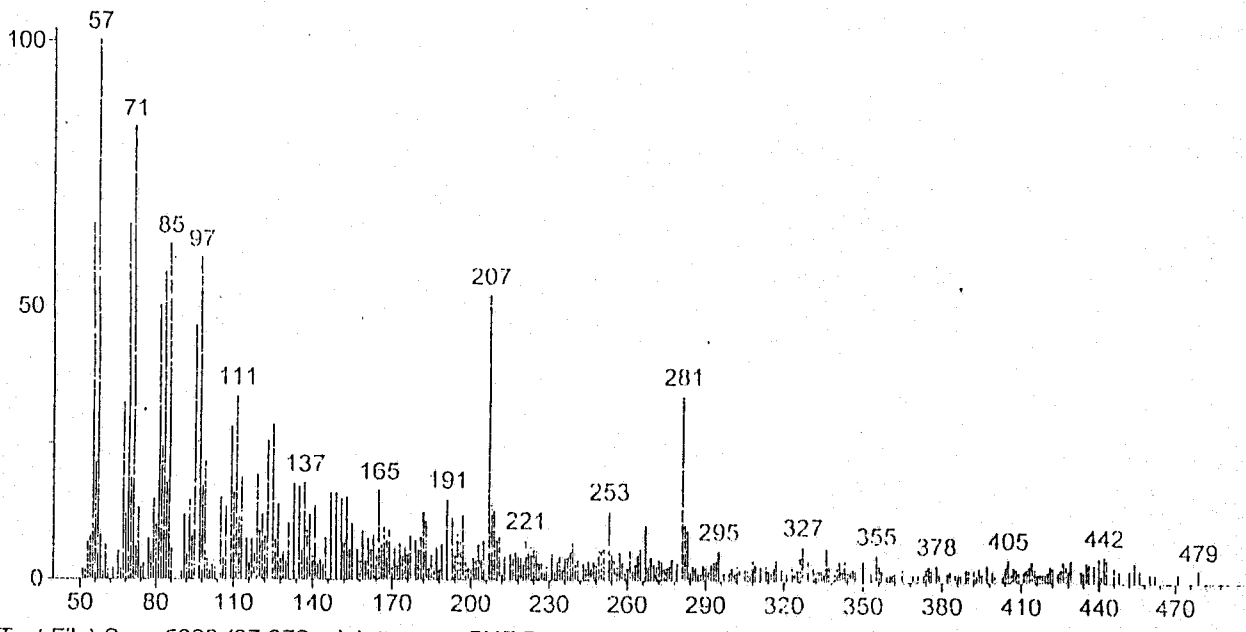
5.1 RECOMMENDATION

Further study on this research work is recommended in the following point of view;

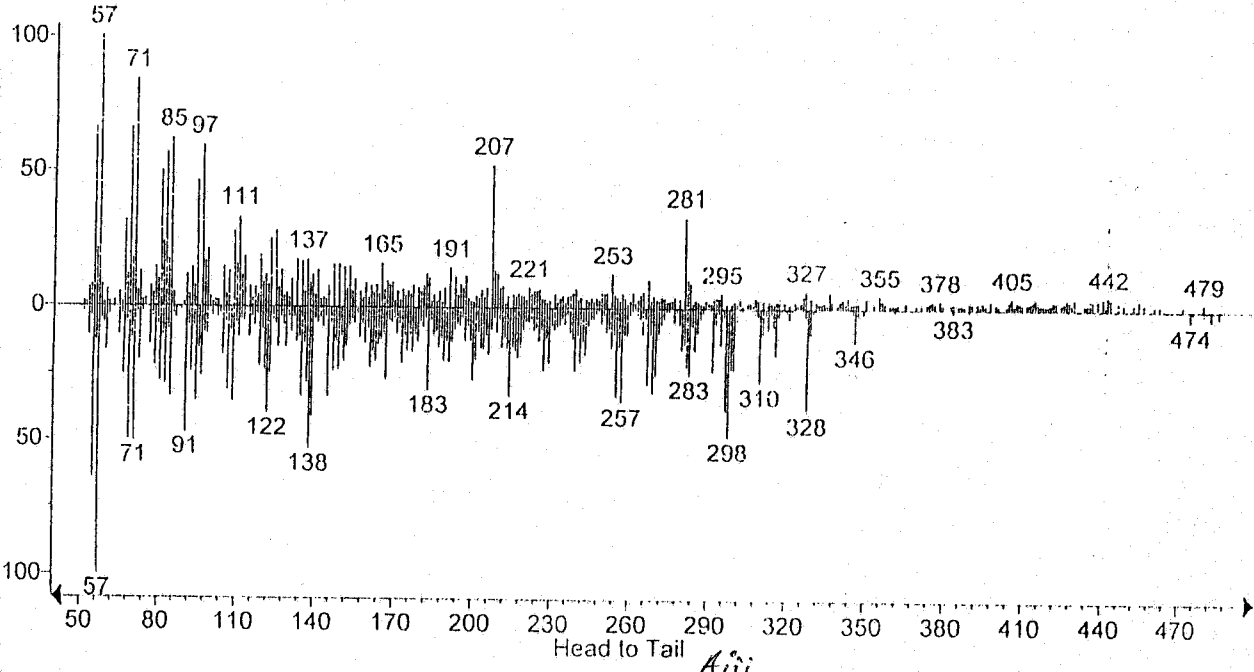
- The product from the degradation should be separated by fractional distillation
- further study is needed and while performing the experiment the nitrogen gas should be to flush the reactor, so as to avoid pressure build up in the system .
- more research should be done on the catalyst to be used.

REFERENCES

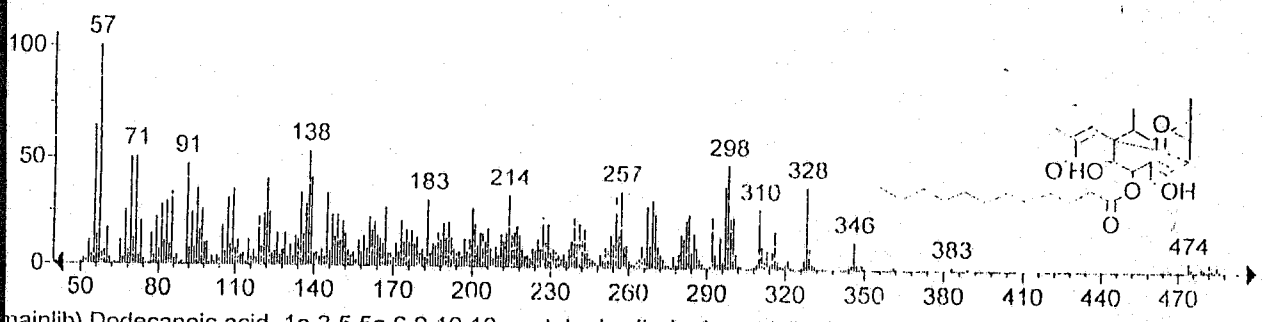
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(Text File) Scan 5993 (37.379 min): TOBA -FUT.D *Aii*



Head to Tail *Aiii*



mainlib) Dodecanoic acid, 1a,2,5,5a,6,9,10,10a-octahydro-5a-hydroxy-4-(hydroxymethyl)-1,1,7,9-tetramethyl-6,11-dioxo-1H-2,8a...

Aiv

**DEVELOPMENT OF ACIDIFIED CLAY CATALYST FOR THE DEGRADATION
OF POLYPROPYLENE AT HIGH TEMPERATURE,**

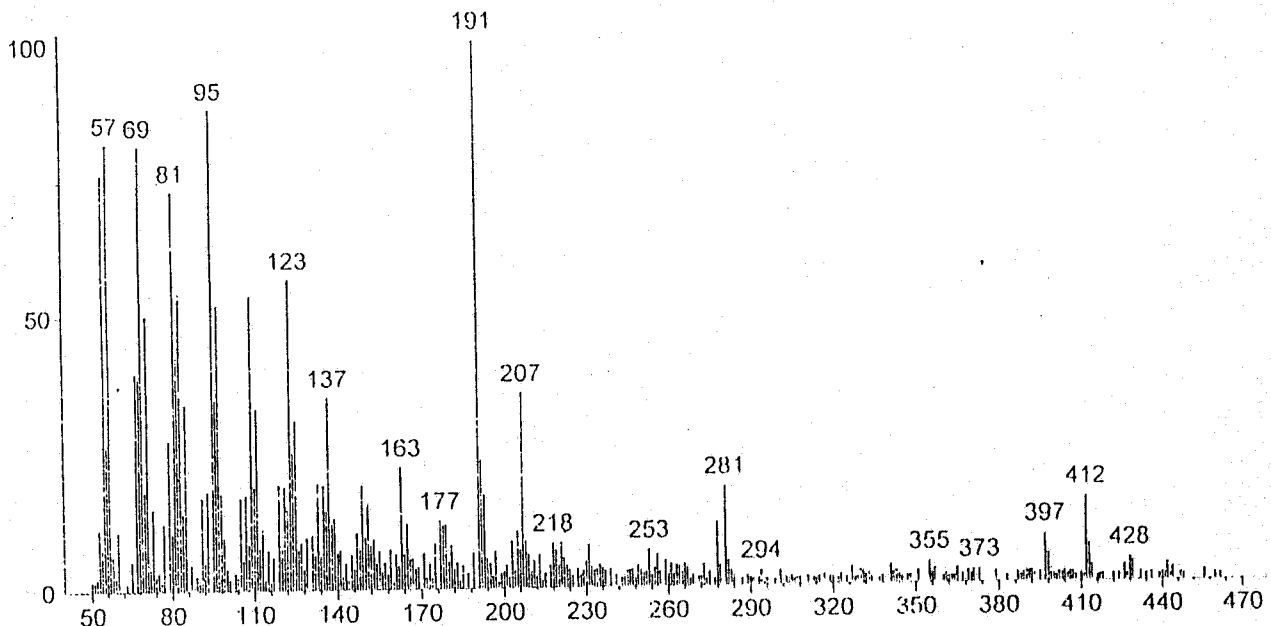
BY

AFOLAYAN TOBA

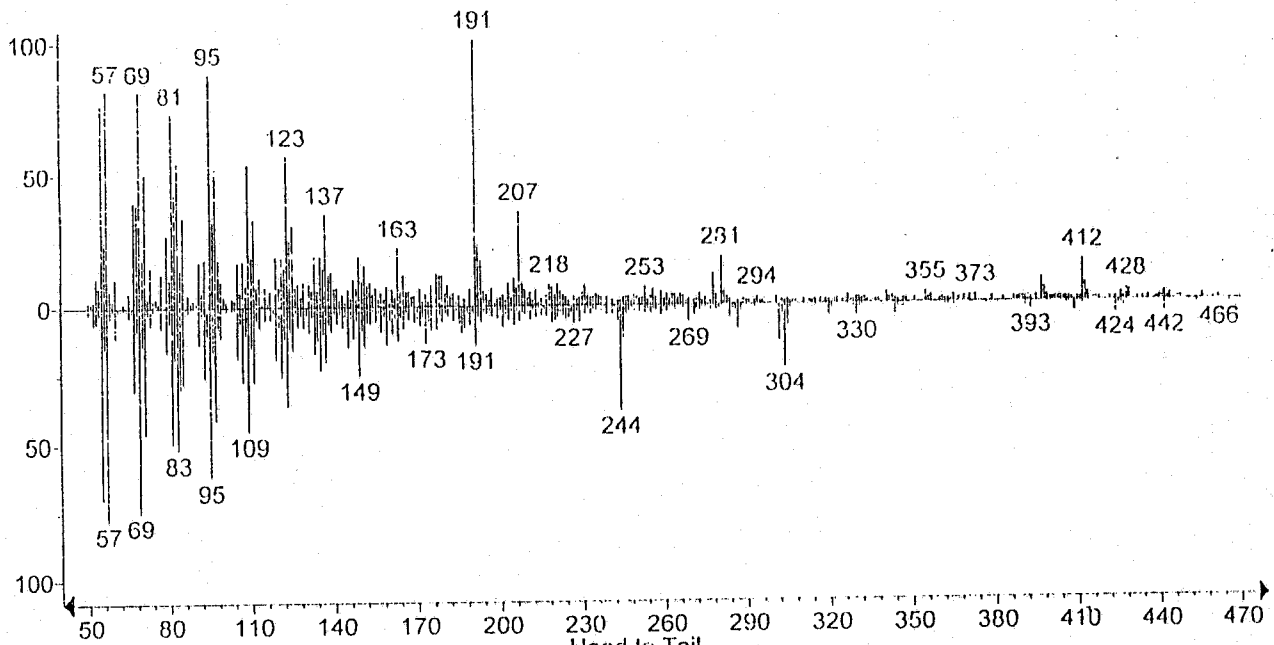
2003/14931EH

**A RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILMENT OF THE
REQUIREDMENT FOR THE AWARD OF BACHELOR OF ENGINEERING
(B.ENG) IN CHEMICAL ENGINEERING DEPARTMENT OF THE FEDERAL
UNIVERSITY OF TECHNOLOGY MINNA, NIGER STATE,**

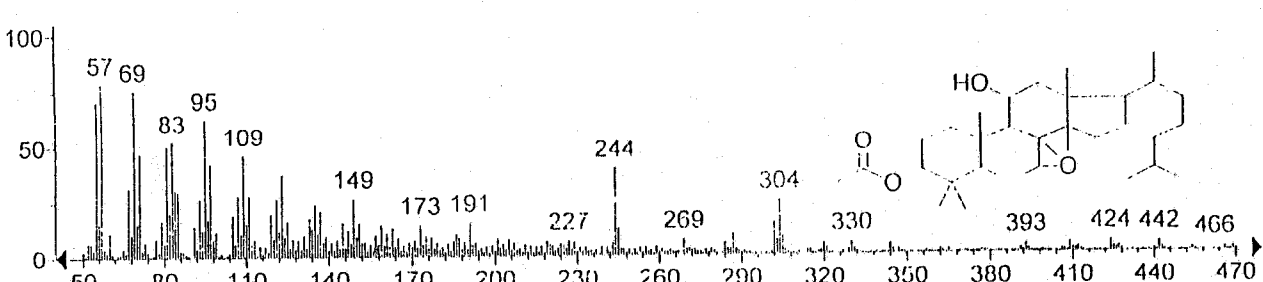
NOVEMBER, 2008



(Text File) Scan 5438 (34.203 min): ISMAIL-FUT.D *Air*



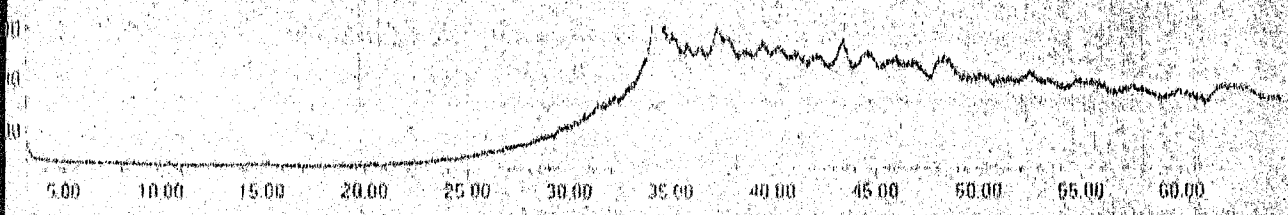
Head to Tail *Air*



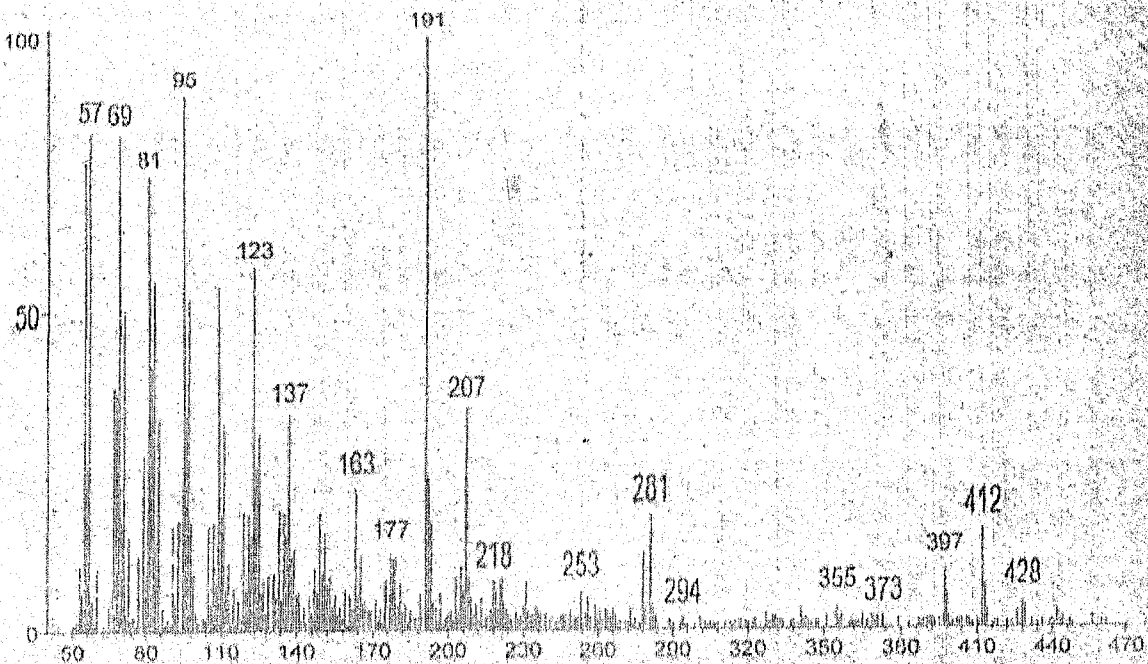
(mainlib) 7,8-Epoxyanostan-11-ol, 3-acetoxy- *Air*

Path : C:\MSDCHEM\1\METHODS\FIXED_OILS4.M\ISMAIL-FUT.MX
Date : 26 Oct 2008 12:55 using AcqMethod FIXED_OILS4.M
Client : Instrument #1
Name : Gasoline
File : Dissolved in acetone

TIC ISMAIL-FUT.MX

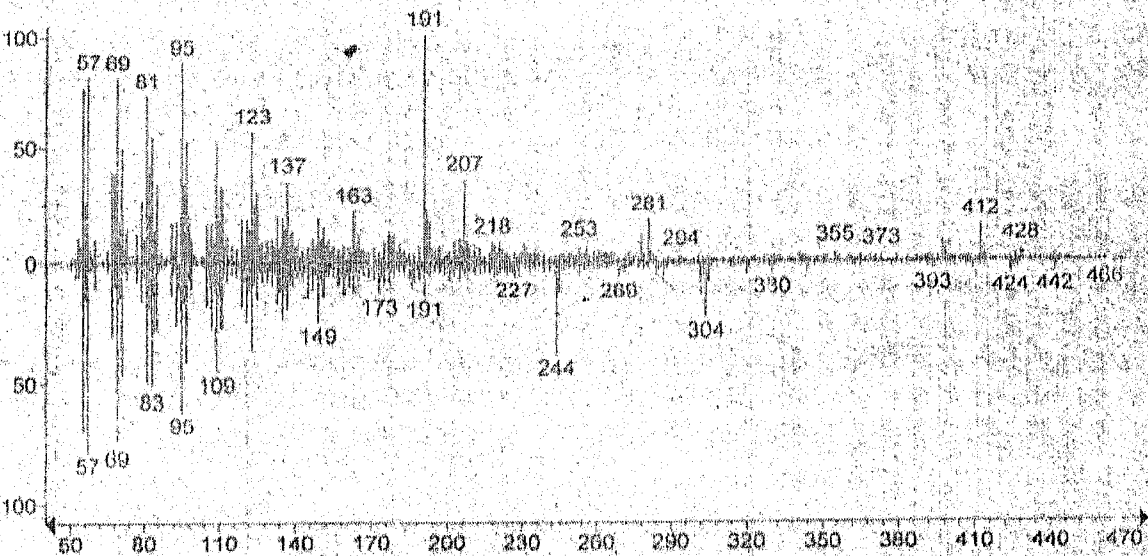


B1



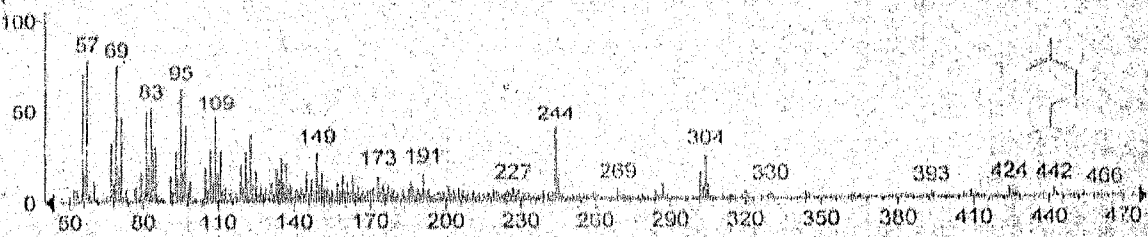
(Text File) Scan 5438 (34.203 min): ISMAIL-FUT.MX

Bii



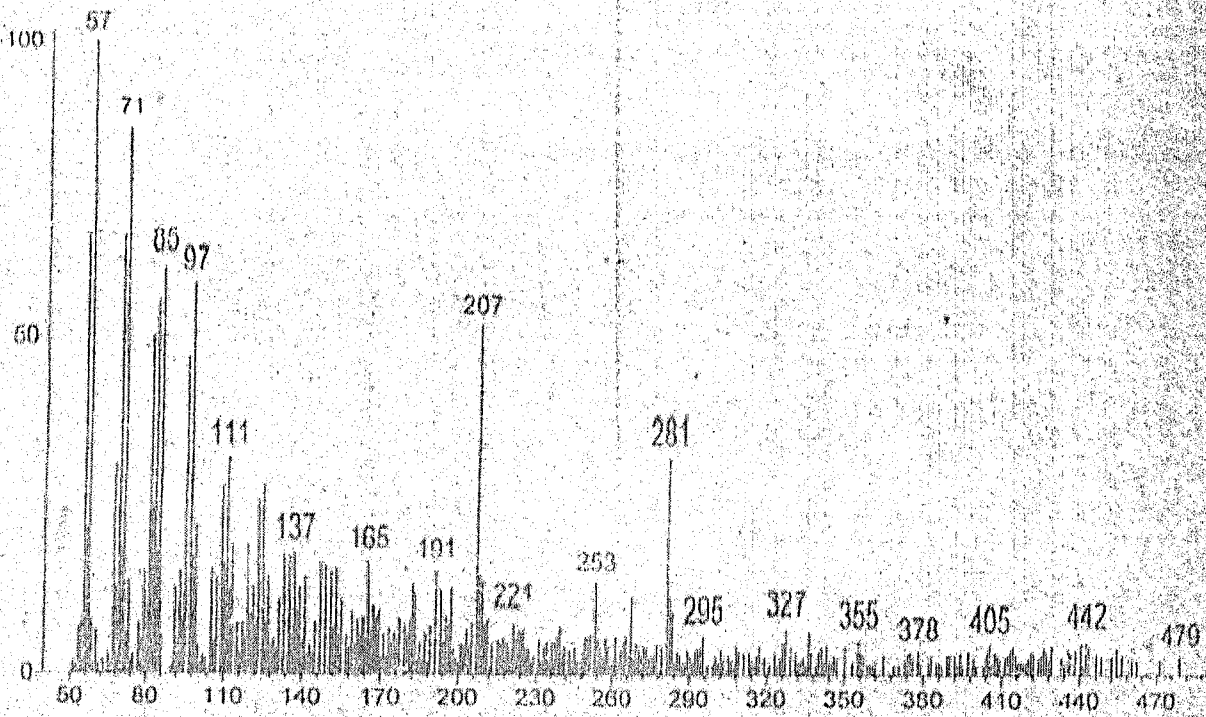
Head to Tail

Biv



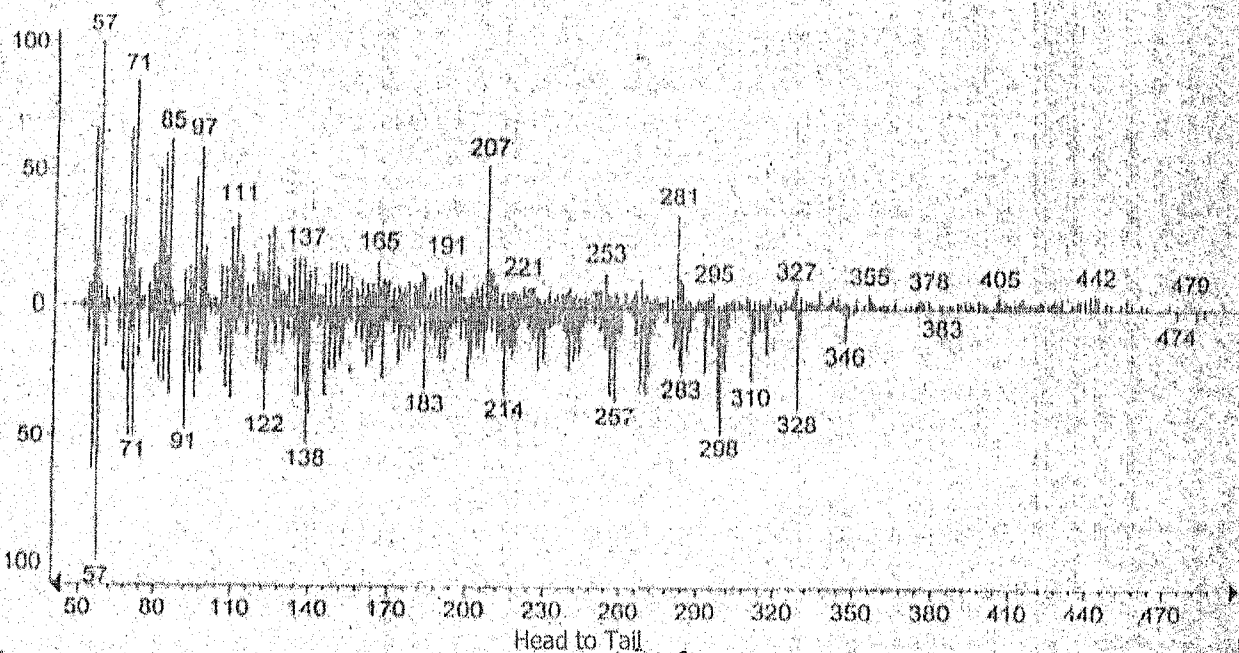
(mainlib) 2,6-Dimethylheptane

Biv



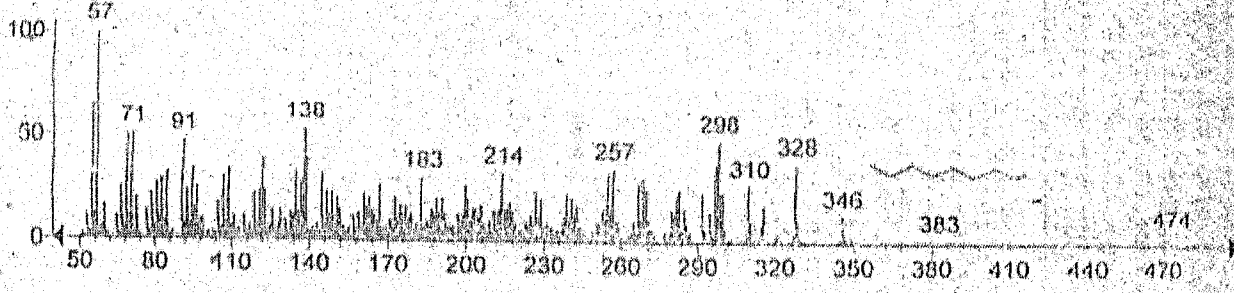
(Text File) Scan 5993 (37.379 min): ISMAIL-FUT.MX

Bii



Head to Tail

Bii



(mainlib) Nonane

Biv