

# Design And Fabrication of a Model Demonstrative Modular Refinery

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**Abstract-** *The Modular refinery is a mini refinery used worldwide to assist conventional refinery to increase rate of production. All refineries, in spite of the size, perform three basic steps which are Separation (fractional distillation), Conversion (cracking and rearranging the molecules), and Treatment. The design and fabrication of a model demonstrative modular refinery was done with sophisticated, using steel metal tanks, pipes, concretes, heater, thermometer gauge and a cooler unit. Nigeria's petroleum refinery industry is also grossly inadequate to meet the petroleum energy demands of the economy. The fabricated modular refinery will help to refine crude oil in on low scale crude in the country to meet this domestic petroleum energy demand.*

**Indexed Terms-** *Modular, fabrication, crude oil, refinery.*

## I. INTRODUCTION

Modular refinery is a mini refinery used worldwide to assist conventional refinery to increase rate of production. It reduces cost and time of construction when compare to conventional refinery, and it is a simplified flow chart that separates crude oil into specific boiling range (carbon number) fraction in the crude distillation processes, through a processing tank, the distil products move through the upper chamber of the tank to the pipes and flow through the air gas separator unit to the coolant unit and the final separator unit were different products are separated into receiver tanks for cracking, rearranging the molecules and treatment. All refineries, in spite of the size, perform three basic steps which are Separation (fractional distillation), Conversion (cracking and rearranging the molecules), and Treatment [1].

Modular refinery is a simplified flow chart that separates crude oil in to specific boiling range (carbon number) fraction in the crude distillation processes that refine range of high-quality fuels and other products [2]; it is constructed and fabricated with sophisticated; steel metal tanks, pipes, concretes, heater, thermometer gauge and a cooler unit.

The production rate is determined by the size of the tank and the rate of energy applied. The refinery process is fractional distillation from thermal energy of different ranges from a processing tank, the distil products move through the upper chamber to the pipes and flow through the air gas separator unit to the coolant unit, the coolant unit regulates the temperature of some products that need to be regulated, the product flow to the separator unit were different products are separated into receiver tanks according to their temperatures and products produced for further processes.

## II. LIMITATIONS IN NIGERIA'S PETROLEUM REFINERY INDUSTRY

Nigeria's refining capacity is currently insufficient to meet domestic demand, forcing the country to import petroleum products. In fact, Nigeria is the only major oil producing country in the world without adequate domestic refining capacity. Nigeria's state-held refineries (Port Harcourt I and II, Warri, and III Kaduna) have a combined nameplate capacity of 445,000 bbl/d, but problems including sabotage, fire, poor management and a lack of regular maintenance contribute to the current operating capacity of less than 100,000 bbl/d [3].

The following challenges, associated with regularization and political instability has slowed down investment in new refineries. The government

over the past few years has entered agreements with both local and international investors to build New Greenfield refineries at a number of locations across the country, these new refineries however are yet to materialize [4].

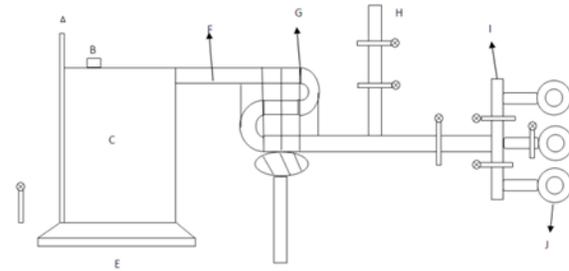
Petroleum energy has literature has further proved, would be the major source of energy for the global economy in general and the Nigerian economy in specific over the next three decades [5]. Nigeria's petroleum refinery industry is also grossly inadequate to meet the petroleum energy demands of the economy. There is therefore the need to build modular refineries in the country to meet this domestic petroleum energy demand. However, the construction of large public-owned refineries in the country is not considered a viable option. The awareness of all these information notwithstanding, there is a dearth of policy analysis and direction on the petroleum energy requirement for the national development agenda or the viability of the modular petroleum refinery alternative to large refineries in order to meet the national petroleum product demand.

### III. METHODOLOGY

The objective of this research work is to design a proto-type refinery with the concept of crude oil refinery process from the temperature changes, distillation, flow chart through different units to the separation stage were all the products will be separated for conversion and treatment. This research is focused on the design and fabrication of a demonstrative modular refinery that refines crude oil into separate products by change and increase in temperature.

- Design Model

Designing of model modular refinery is prepared on a paper work and design with AutoCAD software. This enhances the modeling of the component modular refinery, by visualizing the model before the fabrication process. The design and modeling of the modular refinery are shown in the figure 1.



A- Thermometer; B -loading valve; C -Storage Tank; D - Outlet to Sewer Tank; E - Heater Units; F -Pressure Pipe; G - Coolant Unit; H- Gas Pipe Pressure/Flare; I - Control Unit for Distribution of Products; J- Receiver Tanks; K - Rigidity Support

Fig. 1: Design and modeling of the modular refinery

The research was designed and fabricated within a timeline of eight months. Figure 2 shows Flow chat of the design and fabrication of a model demonstrative modular the refinery.

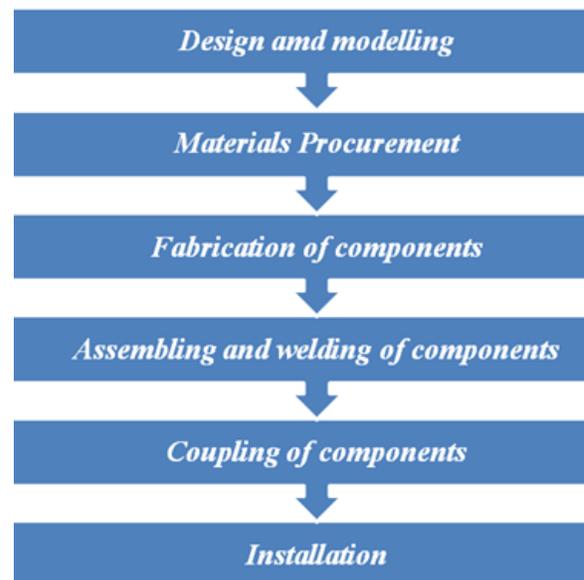


Fig. 2: Flow chat of design and fabrication of a model demonstrative modular the refinery

Bill of Engineering Quantity and Measurements of the modular refinery is shown in table 1.

Table 1: Bill of Engineering Quantity and Measurements of the modular refinery

S/N	Description of items	Quantity
1	3mm stainless steel shell sheet	20
2	1/2 mm stainless steel pipe	15
3	1/2mm control steel valve	13
4	1/2mm stainless steel elbow	20
5	Pressure gauge (165 bar)	4
6	Union stainless steel connector	25
7	Gauge 12 mild steel electrode	1
8	Cutting disc	9
9	Thermometer gauge	1
10	16mm rode	10
11	Wire mesh	1 roll
12	Concrete/ coolant unit	265,000
13	Oxy-acetylene gas	2 set
14	3 phase circuit breaker(160 Amp)	1
15	8mm electrical cable	1 role
16	Contingency	
17	Installation	248,000
18	Transportation	134,000

Figure 3 shows the fabricated modular refinery.



Fig. 3: Fabricated modular refinery



Fig. 4: Modular refinery

### CONCLUSION AND RECOMMENDATIONS

Since Nigeria's petroleum refinery industry is grossly inadequate to meet the petroleum energy demands of the economy, there is need to build modular refineries in the country to meet the domestic petroleum energy demand, thus the design and fabrication of modular refinery is importation to crude refining as an alternative to conventional refinery. This research work has demonstrated the technology involved in modular refinery design and fabrication. This research has also localize the concept of crude oil refinery, and creates the opportunity to be familiar with the components and facilities used in crude oil refinery especially those that wish to specialized in petroleum option. This research will positively reposition the technology of local modular refinery in oil and gas industries. It will serves as an avenue to create jobs opportunities and increases National competitive advantages in the midst of rapid technological change and globalization of markets.

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