

PRODUCTION OF PETCOKE AT REFINARIA DO NORDESTE¹

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Abstract

The Delayed Coking Units – DCU – are adequate to the scheme for processing heavy oils where the market of fuel oil or asphalt is low or not profitable. The DCU's are conversion units that produce, in addition to the gas and liquid distilled products, the petcoke. The petcoke, depending on the characteristics, is used in various applications like as in the aluminum, iron, thermoelectric and cement industries. The petcoke is solid and its logistics is quite different from most of the products handled by Petrobras; therefore, this product has been a constant challenge in relation to the market requirements. Due to the importance of the DCU at Refinaria do Nordeste, and the petcoke production capacity, the coke handling system was projected in order to ensure the refinery operational continuity. The project permits the expedition and loading of 10,000 tons of petcoke within a period of 12 hours of work for cargo vessel. In the development of the processing project of Refinaria do Nordeste efforts were made to optimize the Delayed Coking Unit for the production of distilled products and the quality of the coke. The DCU operating conditions were projected so as to produce petcoke with quality adequate to the iron and aluminum industry.

Key words: Petcoke; Refinery; RNEST; Ferrous metallurgy.

A PRODUÇÃO DE COQUE VERDE DE PETRÓLEO NA REFINARIA DO NORDESTE

Resumo

As Unidades de Coqueamento Retardado- UCR - são adequadas ao esquema para o processamento de petróleo pesados onde o mercado de óleo combustível ou asfalto é baixo ou não se mostra rentável. As UCR são unidades de conversão que produzem além dos destilados líquidos e gás, o coque verde de petróleo, CVP. O CVP, dependendo das características, é utilizado em diversas aplicações como na indústria de alumínio, siderurgia, termelétrica e cimenteiras. O CVP é sólido e a sua logística é bem diferente da maioria dos produtos movimentados pela Petrobras, portanto este produto tem se mostrado um desafio constante frente aos requisitos do mercado. Devido à importância da UCR na Refinaria do Nordeste, e a capacidade de produção de CVP, o sistema de movimentação de coque foi projetado a fim de garantir a continuidade operacional da refinaria. O projeto permite a expedição e carregamento de até 10.000 toneladas de CVP em um período de 12 horas de trabalho para navio cargueiro. No desenvolvimento do projeto de processo da Refinaria do Nordeste buscou-se otimizar a unidade de Coqueamento – UCR – para a produção de destilados e da qualidade do coque. As condições operacionais da UCR foram projetadas de modo a produzir o CVP com qualidade adequada à indústria siderúrgica e de alumínio.

Palavras-chave: Coque verde de Petróleo; Refinaria; RNEST; Siderurgia.

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1 INTRODUCTION

With the alterations in the quality of the national petroleum produced, Petrobras has adapted its refineries to process it and meet the demand of the fuel market. In order to adapt and optimize the processing of oils with low °API and high asphaltene contents of, researches are made in laboratories and pilot plants, as well as industrial testes and basic engineering projects.

To add value to the national light crude oil in relation to the more expensive imported light crude oils, Petrobras has been investing primarily in units known as “bottom of barrel” and hydrotreating units, optimizing the yields of “noble” byproducts (gasoline and diesel), also in order to supply the current energy matrix and that projected for the future. The “bottom of barrel” units are conversion units that process the heaviest fractions of the oils – the crude residue, and the hydrotreating units are those that stabilize the products within the specifications required by the market through hydrogenating reactions.

Among the waste conversion units, the DCU is one of the solutions for the Brazilian refining scheme, adding value to the oil heavy fraction. The DCU maximizes the medium distillate production of the refinery, which after hydrotreating is sent to the diesel pool, a product highly consumed in this country and of a social nature. The conversion of “heavy” fractions at the DCU produces, in addition to the gas and liquid distilled products, the green petroleum coke. The product is referred to as “green”, due to the fact that the coke is not calcined, i.e., it still contains the light fractions that are added to the coke. The petcoke, depending on its characteristics, can be used in various applications: aluminum, iron, thermoelectric, cement industries, etc.

Petroleum coke is a solid and its logistics is quite different from most of the products handled by Petrobras; therefore, this product has been a constant challenge in relation to the market requirements. The greatest challenges faced in the handling of coke are in the quality of the product (granulometry, for example), in the areas of operation and maintenance of the equipment and the environmental matters.

The Petrobras DCU's, which are being projected by the CENPES and constructed in the country, in addition to the seven units currently in operation, have revealed great evolution in the operational conditions and projects of the equipment with reflexes on the quality of the products, profitability of the refinery and compliance with the environmental legislation. When compared to the refineries abroad, the PETROBRAS DCU's are competitive not only in the project and operation but also in the production of high quality coke with great importance for the coke handling system.



Figure 1: Petcoke

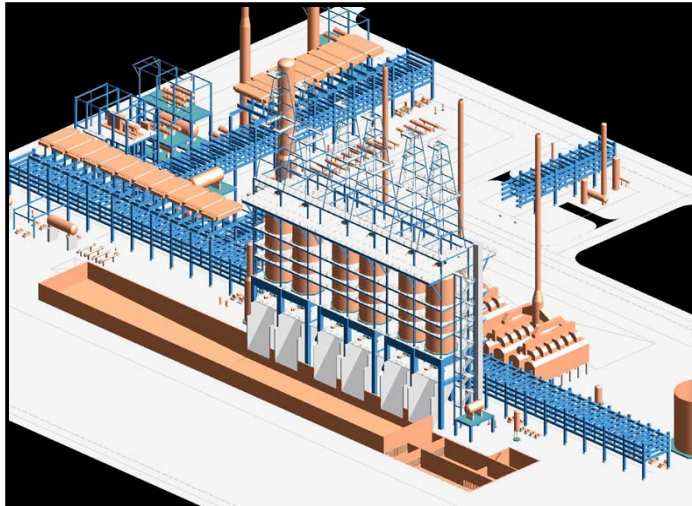


Figure 2: Delayed Coking Unit of Refinaria do Nordeste

2 MATERIAL AND METHODS

In the project of Refinaria do Nordeste, RNEST – Refinaria Abreu e Lima – there is the prediction of a large amount of coke produced because of the quality of the petroleum and feedrate of the DCU's.

Studies about the scheme of refining and profitability of RNEST reveal that the petroleum processing capacity of RNEST is of 200,000 bpsd (31.800 m³/dia). The oils that were used as the basis for the study was Marlin 16°API and Carabobo synthetic oil 16°API (Venezuelan synthetic petroleum resulting from 8°API crude oil). The best refining scheme to supply the diesel market, and with the smallest investment, contemplates only the atmospheric distillation units, DCU, diesel and gasoline hydrotreatments, and the gas generation units, besides the typical units of a refinery.

Since the refining scheme does not predict vacuum distillation units, for economic and technological reasons, the DCU capacity is high due to the volume of atmospheric crude residue of the base oils. However, physical limits of some equipment items defined the maximum capacity of the DCU. As a result, two units were defined, and the feedrate of each DCU is of 10,500 m³/d.

Each DCU, Cenpes/Petrobras project, has six coke drums, with feed from different origins, which shall produce different types of coke: fuel, ferrous metallurgy and anode. In order to meet the feed demand and the limitations of the drums operation, the drum operation cycles shall be of 18 hours, with the decoking phase (removal of the coke produced in the drum) every 6 hours, producing nearly 650 t/d of coke per drum, which amounts to approximately 5,200 t/d of petcoke at the two DCU.

RNEST shall be installed in Ipojuca, in the State of Pernambuco, less than 10 km away from the Port of Suape, through which most of the final expedition of coke to the clients shall be made. Currently, the local market of coke is supplied by the imports made through the Port of Recife, in small amounts though. Among the main parties interested in the coke produced from the waste of the national petroleum, with low contents of sulfur and metals are the ironworks and the calcinations units, which sell to the aluminum industry.

The quality of the coke produced at the RNEST will depend on the feed processed, since the equipment items are dimensioned to operate under the most severe operating conditions required by the process. The possibility to produce coke for fuel and ironworks is predicted in the project of the unit. Depending on the quality of the feed, the DCU also produces the anode type coke – a product of higher added value.

In the iron making industry, due to its low sulfur contents, Petrobras petcoke is a substitute for coal. Some of the important features for its use as a substitute for coal are: the low contents of ashes, high contents of fixed carbon and high calorific value.

Some options for use that were approved for the Petrobras coke in the iron producing industry:

- At the coke plants, as a carbon provider and ash reducer, as a substitute for coal, for the production of metallurgic coke’.
- In blast furnaces, in PCI (Pulverized Coal Injection).
- In small and average-sized ovens, as a substitute for charcoal, for the production of pig iron.
- In the pelleting and sintering processes.

Petrobras, due to its huge investment portfolio, is expecting a significant increase in the production of petcoke, as shown in Figure 3:

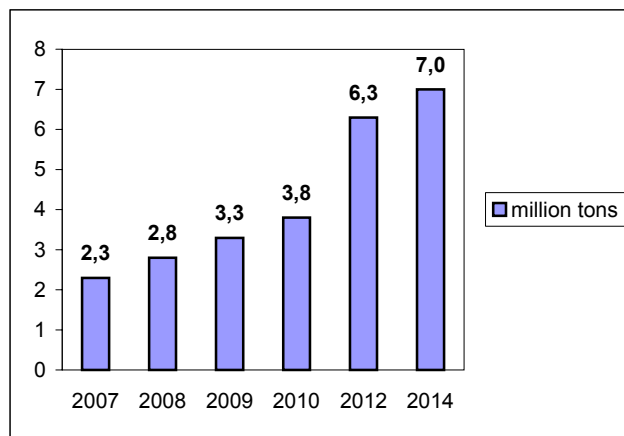


Figure 3: Petrobras estimated petcoke production

The project of the RNEST processing units emphasized the quality of the products, permitting the diesel and naphtha produced to comply with the national quality standards, (also predicting the production of biodiesel, a product composed with vegetal oil, which is renewable fuel of an environmental nature).

Systems to reduce dust through sprayers with chemical products and “live fences” were predicted for the storage area, to comply with the environmental requirements and retain the coke dust. The “live fences” are formed by trees of various sizes, which will impair the passage of the wind and prevent the coke dust from spreading into the environment. Protection screens are also predicted, with adequate thickness and specifications to impair the passage of the wind. To protect the environment around the refinery and port, there will be a system to wash the tires of the trucks used in the transport of the product. The waste water will be conducted

to a settling basin and then reused in the system, without any losses or contamination of the groundwater.

This way, in the next few years, PETROBRAS intends to construct the largest petcoke producing unit in Brazil, and provide the northeast region with light distilled products and diesel.

Acknowledgement

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