

Upgrading Fossil Resources in Colombia

by Consuelo Montes de Correa and
Aída luz Villa de P.

A short profile of the Colombian fossil resources and their use for the production of chemicals is presented. Significant developments in the petrochemical sector have taken place in periods of sufficient oil/gas reserves. So, the petrochemical industry in Colombia is comparatively more developed than carbochemistry. Notwithstanding, new petrochemical complexes are required in view of the current and expected local demand of refined oil/gas and basic raw materials.



The proven oil reserves in Colombia stand at about 2.6 billion barrels [1]. However, the potential of hydrocarbon-producing resources has been estimated at 37 billion barrels of oil equivalent, 70% of which correspond to liquid hydrocarbons and 30% to gas [2]. Colombian oil production is located mainly in the Cusiana and Cupiagua fields in the eastern Andes foothills, and in the Caño Limón field near the Venezuelan border [1].

These crudes are of excellent quality. Their API gravity ranges between 40 and 29 degrees and their sulfur content between 0.15% and 0.50%. However, there are other reserves, about 134 millions of barrels, which consist of heavy crude oil with API gravities ranging between 12-13 degrees and containing higher amounts of sulfur (1.3%) and metals like Ni and V. During 2000, Colombia exported almost 50% of the country's total production of crude oil to the United States (332 thousands of barrels per day).

Most of Colombia's coal is located in the country's Caribbean coast. Estimated coal reserves are about 6.7 billions of tons. Colombia is the largest coal producer in Latin America and one of the largest coal exporters in the world since its coal is relatively clean-burning, with a sulfur content of less than 1% [1].

Oil refining

Colombian refineries are 100% owned by Ecopetrol, a government company that operates under the Ministry of Mines and Energy. It supplies 75% of all refined products and a significant percentage of the basic materials for petrochemicals needed by Colombian industries. Ecopetrol has two large refineries: Barrancabermeja and Cartagena. The current refining capacities are 220 and 75 thousands of barrels per day, respectively [3].

Since its beginnings in 1922, the Barrancabermeja Industrial Complex has grown to be the main Colombian petrochemical complex having over 50 different plants. The products from this refinery are gasoline, middle distillates, propane gas, dis-solvents, fuel oil, aromatic tar, sulfur, asphalt, naphtenic acid, polyethylene, aromatics, cyclohexane, alkylbenzene 12, lubricants and paraffin [3].

The products from the Cartagena refinery are: gasoline, propane gas, middle distillates, fuel oil and asphalt. Ecopetrol has three more very small refineries. In these plants, Ecopetrol produces fuel oil for its own use. Table 1 shows the volume of selected products from refining [3]. Despite Colombia is a net oil exporter it imports gasoline since the current production does not meet domestic demand [1]. In August 2000, Ecopetrol designed a short-term plan to import heavy oil from Venezuela and Ecuador in order to produce lower cost derivatives, such as diesel, solvents and jet fuel. This strategy was employed in order to export more of the lighter, sweet crude [1].

The manufacture of important petrochemical basic raw materials is limited to a small scale production of ethylene, cyclohexane and aromatics. For example, ethylene is recovered from refinery gases and used in the production of low-density polyethylene. Benzene is recovered from the reforming process to produce detergent alkylate and cyclohexane. A brief comparison [3] of the estimated production capacity vs local demand for the main petrochemical basic raw materials is presented in Table 2. As can be observed in the third column of this table, there is a deficit of most products.

Ecopetrol is planning to expand and modernize both refineries for the production of olefins (ethylene, propylene), aromatics, intermediate products and other derivatives required in the local market. Notwithstanding, it would be possible if new reserves were found [3].

Accordingly, the government has been trying to attract new investments since 1999. A record of 32 contracts for explo-

C. Montes di Correa, A. luz Villa de P., Departamento de Ingeniería Química, Universidad de Antioquia - Medellín (Colombia).

Table 1 - Estimated volume of products from refining [3]

Product	Production	Product	Production
Gasoline	100.000 (BPD)	Gasoline (aviation)	373 (BPD)
Medium distillates	85.750 (BPD)	Propane gas	21.812 (BPD)
Fuel Oil	54.100 (BPD)	Lubricants	1.210 (BPD)
Paraffin	230 (BPD)	Solvents	1.180 (BPD)
Asphalt	7.730 (BPD)	Cyclohexane	650 (BPD)
Aromatics	1.450 (BPD)	Diesel Oil	83 MGPY
Fuel oil No.6	867 MGPY	Lubricant greases	10 MkgPY
Kerosene	62 MGPY	LPG	251 MGPY
Lubricant oils	71 MkgPY		

BPD: barrels per day, MGPY: million gallons per year, MkgPY: million kilograms per year

Table 2 - Colombia's estimated production capacity vs local demand for the main petrochemical basic raw materials (ktons) [3]

Product	Production capacity	Demand	(Deficit)/ Surplus
Benzene	43	23	20
Ethylene Glycol	0	37	(37)
Ethylene Dichloride	0	2	(2)
o-Xylene	9	15	(6)
p-Xylene	0	0	0
Cyclohexane	28	28	0
2-Ethylhexyl Alcohol	0	12	(12)
Phthalic Anhydride	15	14	1
Polyethylene	55	200	(155)
LDPE	55	115	(60)
LLDPE	0	450	(450)
HDPE	0	70	(70)
PET (1)	92	115	(23)
PVC	332	246	86
Polypropylene	140	116	24
Polystyrene	100	100	0
Styrene	0	72	(72)
Styrene-Butadiene	0	24	(24)
Terephthalic Acid	0	31	(31)
Vinyl Acetate	0	11	(11)
Vinyl Chloride	0	170	(170)

(1) Polyethylene-Terephthalate in Barrels Per day (BPD)

ration or incremental production were awarded in 2000 and it was expected to decide 30 more contracts in 2001 [1].

Private industry

In the late 1950s the private petrochemical industry started with the production of finished plastic products, paints, tires, synthetic fibers and agricultural chemicals [3]. At the beginnings, all raw materials were imported. As the local demand reached significant levels, few foreign companies decided to construct some of these plants directly or under joint ventures with local industrialists.

The most traditional one is Monómeros Colombo Venezolanos, which produces caprolactam, cyclohexane and many other chemicals. Another group of companies known as

the Sandford group, initiated in the early 1960s and are engaged in producing raw materials for the petrochemical/plastic industry or plastic products.

Polypropylene, polystyrene, PVC suspension and emulsion, polyethylene, low density polyethylene (LDPE), and polyols are some of the raw materials manufactured by the plastic industry.

The plastic sector accounts for over 60% of all basic raw materials imported or produced in Colombia.

Coal

Coal mines in Colombia are owned by foreign private companies. Coal production is approximately 25 billions tons per year from which 5.5 millions are consumed mainly as combustible [4]. The rest, are exported to more than about 27 customers.

The main consumers are United Kingdom, Portugal, France and Israel [5]. The use of coal for chemicals is scarce in Colombia. The most important company, Carboquímica S.A. initiated tar distillation operations in 1956 [6]. Its products were used in many applications, including the covering of gas and sewage pipelines.

Later, it started the production of phthalic anhydride and plasticizers even using naphta as the starting material. In 1994 it merged to Polyquimicos S.A., which produced heat stabilizers for PVC and lubricants, among others. Besides, Polyquimicos used to commercialize other products from these sectors. In the year 2000 Carboquímica S.A. expanded its operations to Venezuela generating higher geographic covering and complementing its product lines [6].

Conclusions

Potential oil reserves in Colombia are highly promising but hardly explored. So, there is a great challenge to ensure additional investments in oil exploitation to allow a long-term development of the Colombian petrochemical industry. On the other hand, political-economical trends indicate that at least in the near future, coal is not likely to compete with oil for the production of chemicals in Colombia.

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