RESUMEN

El procesamiento del gas natural para la extracción del etano e hidrocarburos superiores es una actividad de gran importancia dentro del sistema gasífero de un país. El etano constituye la materia prima fundamental de la denominada petroquímica base gas, mientras que propano, butanos, pentanos y superiores, se comercializan fundamentalmente como combustibles.

En el caso de Argentina, la actividad de procesamiento forma parte del sistema de transporte y distribución de gas natural, el cual se encuentra regulado para asegurar una adecuada provisión de este insumo a los consumidores industriales y domiciliarios. Por este motivo suelen existir restricciones sobre la cantidad de hidrocarburo que puede extraerse del gas disponible. Por otra parte, el negocio de extracción se encuentra sujeto a la incertidumbre inherente a los mercados en lo que respecta a demanda y precios de los productos del procesamiento así como a la variabilidad de los gasoductos en cuanto a calidad y cantidad de gas a procesar. Como consecuencia, esta actividad se encuentra sometida a una gran variabilidad a lo largo del año, lo que dicta la necesidad de ajustar en forma permanente la operación de los complejos de extracción para optimizar el negocio. Dada la complejidad estructural de las plantas de extracción modernas, esta tarea puede verse beneficiada por la disponibilidad de herramientas de asistencia en la toma de decisiones basadas en modelos matemáticos de optimización.

En esta tesis se presenta un modelo matemático para optimizar la operación del complejo de extracción de hidrocarburos instalado en la localidad de Gral. Daniel Cerri próxima a la ciudad de Bahía Blanca. El modelo no-lineal mixto-entero propuesto contempla las múltiples opciones de mezclado disponibles en el complejo así como la posibilidad de operar o pasar a reserva sus cinco plantas de extracción de hidrocarburos. Dichas plantas poseen diferentes tecnologías de extracción y por lo tanto rendimientos distintos en función de sus respectivas variables operativas.

Los resultados del modelo se comparan contra datos históricos del proceso para cinco escenarios operativos frecuentes a lo largo del año, con el objeto de cuantificar los potenciales beneficios de su aplicación sistemática. Se presentan además diversas aplicaciones con el objeto de ilustrar su uso para asistir en la toma de decisiones tanto a escala operativa, como táctica y estratégica.

ABSTRACT

The processing of the natural gas for the extraction of ethane and heavier hydrocarbons is of fundamental importance within the gas system of a country. Ethane is the basic raw material of the gas based petrochemical industry, while propane, butanes, pentanes and heavier compounds are mainly commercialized as fuels.

In the case of Argentina, the processing activity is a part of the natural gas transport and distribution system, which is regulated by law in order to ensure an adequate provision for home and industrial use. For this reason, constraints on the amount of hydrocarbons that can be extracted from the available gas frequently arise. On the other hand, the extraction business is subject to market inherent uncertainty regarding demands and prices of the products, as well as to the variability of the pipelines regarding quality and availability of raw material. As a consequence, this activity faces a high variability along the year, which dictates the necessity of tuning the operation of the extraction complexes almost permanently in order to optimize the business. Due to the structural complexity of the modern extraction plants, this task could benefit from the availability of decision making support tools based on mathematical optimization models.

In this thesis a mathematical model is presented aimed to optimize the operation of the hydrocarbon extraction complex located in Gral. Daniel Cerri close to Bahía Blanca city. The proposed mixed-integer-nonlinear model considers all the available gas mixing options in the process as well as the possibility of turning-on and shutting-down its five hydrocarbon extraction plants. Such plants possess different technologies and therefore different extraction efficiencies as functions of their respective operative variables.

Model results are compared against historical process data for five frequent operating scenarios along the year in order to quantify the potential benefits of its systematic application. Several applications are also proposed in order to illustrate its use in decision making at operational, tactical and strategic levels.

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