Refinery Modeling

Advanced Chemical Engineering Design

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EXECUTIVE SUMMARY

This report is a refinery planning model for purchasing different crudes to meet a fixed demand while maximizing profit. The model involves 13 typical refinery processes and a blending section. Each unit has been modeled off of existing correlations, kinetic and or pilot plant data. Additional costs for increasing energy requirements were considered negligible because of the increased profit accompanied with minimal manipulations in temperature, pressure, space velocity, etc. A Visual Basic macro that uses Excel Solver was used to best estimate the purchasing requirements. Risk and uncertainty were not addressed in this initial model.

Three crudes were available for purchase from Australia, Kazakhstan, and Saudi Arabia at $71.88, $72.00, $71.20 per barrel respectively. They represent different crudes, (ie. light, sweet, sour, heavy) used in this model. The largest product demand was for regular gasoline (87 octane) at 310,000 barrels per month, with premium gasoline (91 octane) the second highest at 124,000 barrels per month. Their prices were $2.12 and $2.31 per gallon respectively. Contracts locked in specific demand amounts and included penalties for not meeting demand at 1.5 times the selling price.

Overall profit was maximized in this model, and was the objective function. The profit was a function of product sales, crude purchasing costs, and penalties for not meeting demand. The objective function was maximized by manipulation of process variables for each unit, purchasing of different crude amounts, and blending to meet product demands. Penalties for not meeting demand were significant, causing Solver to generate results that exactly met demand.

Two successful positive profit runs were completed maximizing the objective function and maintaining the constraints of each blending index. The maximum profit was $21 a barrel, with 150,000 barrels of Australia Crude, 150,000 barrels of Kazakhstan Crude, and 300,000 barrels of Saudi Arabia Crude. These values were sensitive to purchasing costs because of their similar crude properties. Future work should broaden the range of crudes used, maximize demand that changes over time, and add a wider variety of products.