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OPTIMAL SYNTHESIS OF ENERGY EFFICIENCY IMPROVEMENT FOR NGLS INDIRECT SEQUENCE FRACTIONATION UNIT

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EXTENDED ABSTRACT

Once natural gas liquids (NGLs) have been separated from natural gas stream, they are further separated into their component parts, or fractions, using a distillation process known as fractionation. Distillation is the primary separation process widely used in the natural gas processing. Although it has many advantages, the main drawback is its large energy requirement, which can significantly influence the overall plant profitability. Another question that needs to be answered here is there any systematic study and analysis to improve energy saving for the NGLs fractionation plant without having major modifications to the separation units, which is more practical to implement. The large energy requirement of these processes can be systematically reduced by determining the optimal sequence using driving force method. Therefore, the objective of this paper is to present the study and analysis of the energy saving improvement for the NGLs fractionation plant by using driving force method which will require only minor or less modifications to the separation units. Generally, the concept of driving force was applied in designing an energy efficient distillation column [Gani and Bek-Pedersen, 2004]. However, the concept has been extended its application in designing energy efficient distillation columns sequence [Mustafa *et. al.,* 2014]. To perform the studies and analysis, the energy efficient NGLs fractionation plant methodology is developed. Basically, the methodology consists of four hierarchical steps. In the first step, the energy that is obtained from the base NGLs sequence will be used as guidance for the next step where the base NGLs sequence is developed from a simple and reliable short-cut method. In the second step, the energy efficiency in distillation column will be improved through driving force method where the optimum sequence will be determined in this step. In the third step, the optimum sequence was analyzed in term of energy analysis by using a simple and reliable shortcut method distillation column in Aspen HYSYS environment. In the final step, the comparison between the existing sequence and the optimum sequence by using driving force method will be done and at the same time the economic performance for the optimum sequence is also evaluated in this step. Then, the return of investment (ROI) will be calculated to make sure that the proposed modification to improve energy saving is practical. The capability of this methodology is tested in designing an optimal energy efficient distillation columns sequence of NGLs fractionation unit. The existing NGLs fractionation unit consists of nine compounds (methane, ethane, propane, i-butane, n-butane, i-pentane, n-pentane, n-hexane, n-heptane) with direct-splitter-direct sequence was simulated using a simple and reliable short-cut method within Aspen HYSYS environment. A total of 519.68 MW energy used to achieve 99.9% of product recovery. A new optimal sequence determined by driving

force method was simulated using a short-cut method within Aspen HYSYS environment where a total of 376.60 MW of energy was used of the same product recovery. The results show that the maximum of 27.53 % energy reduction was able to achieve by changing the sequence suggested by the driving force method. It can be concluded that, the sequence determined by the driving force method is able to reduce energy used for NGLs fractionation. All of this findings show that the methodology is able to design energy efficient distillation columns for NGLs fractionation sequence in an easy, practical and systematic manner.

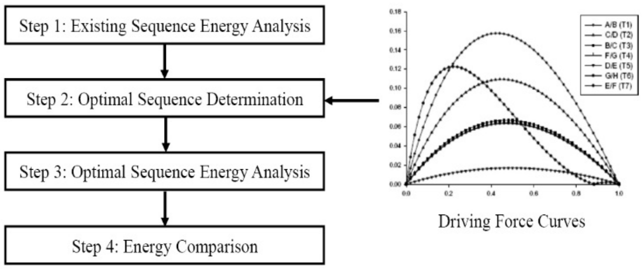

Figure 1: Energy efficient distillation columns sequence methodology [Mustafa *et. al.,* 2014].

Table 1: Feed conditions of the mixture [Long and Lee, 2011]

Feed Condition		
Component	**Mass flows (kg/h)**	**Mole fractions (%)**
Methane	991.66	0.86
Ethane	87179.69	40.45
Propane	87268.17	27.61
i-Butane	26803.59	6.43
n-Butane	57180.35	13.72
i-Pentane	20649.83	3.99
n-Pentane	14600.65	2.82
n-Hexane	17559.16	2.84
n-Heptane	9099.56	1.27
Temperature (^{0}C)	55.83	
Pressure (bar)	31.37	

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