NATURAL GAS PROCESSING SIMULATION

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Reference file: GAIL_Jamnagar1.dwxmz

GAIL, GANDHAR PLANT

INTRODUCTION

GAIL, Gandhar plant is one of the major plants of Gas Authority of India Ltd (GAIL). Natural gas being one of the most important raw materials containing light hydrocarbons with different uses has to be processed to get desired light hydrocarbons for designated usage.

In the Gandhar plant, Natural Gas supplied by ONGC is processed to get LPG, pentane and lean gas as output. The design capacity of the plant is 5.0 MMSCMD, though it is currently running at 4.2 MMSCMD due to decreased supply of Natural Gas as less available currently. This plant is designed by **Engineers India Ltd**. (**EIL**). Many of the plants' equipments have been licensed by various licensing companies, including **SOLAR Turbines Inc.**, **Linde**, **ROTOFLOW**, **PSA Nitrogen Limited** while the Plant Control Interface Software was licensed by **Honeywell automation**. The cost of the project is Rs. 356 crores generating sales of **82 lakhs per day** from LPG, **30 lakhs per day** from Naphtha, **3.5 lakhs per day** from Pentane leading to a consolidated turnover of **3332 Lakhs per month**. The expenditures amount to **2323 lakhs per month**. Thus, GAIL earns a net profit of around **900 lakhs PM**

MOTIVATION BEHIND THE PROJECT

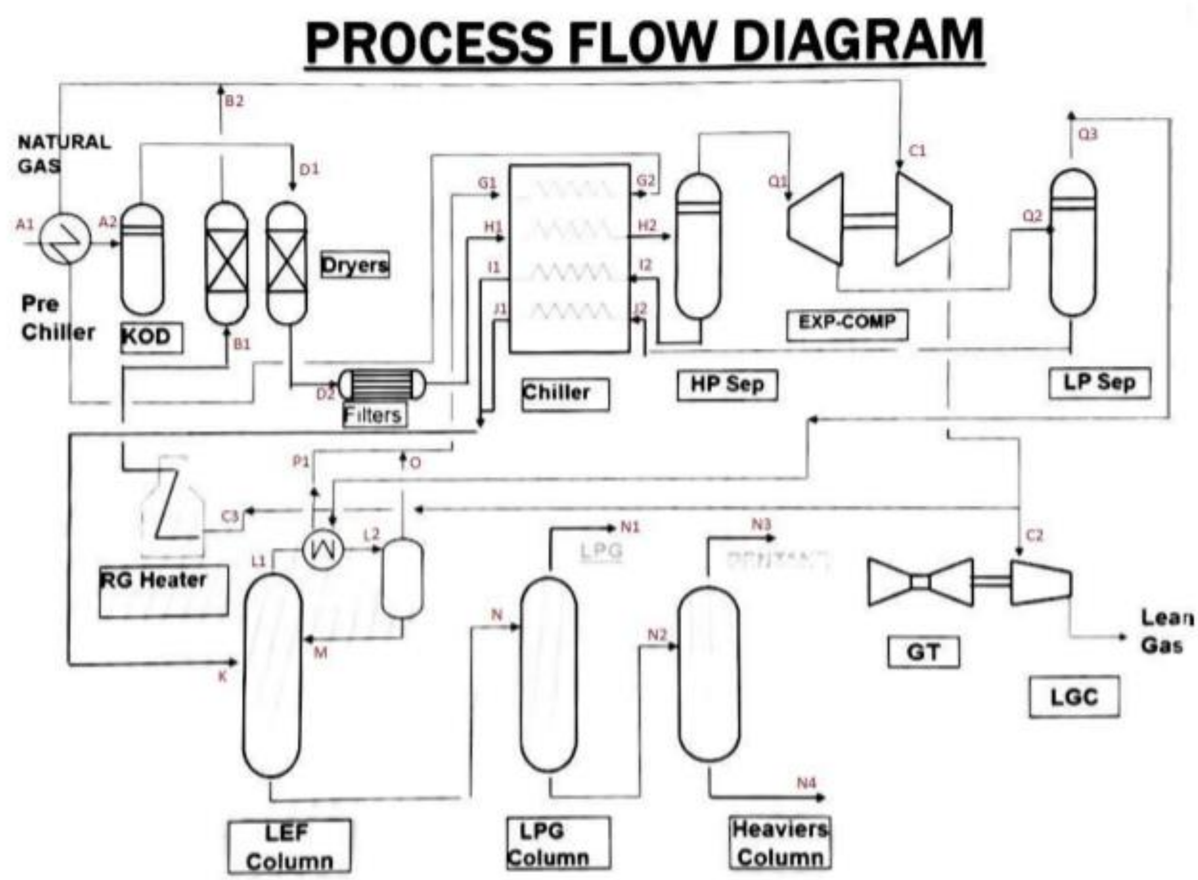
The plant design made of equipments coming from different licensors and currently handling such large volumes of natural gas input makes the simulation necessary to look for various areas of improvement possible. One of the major regions of concern before building such a plant on a large scale is whether the plant will work for the given conditions of equipment working as well as of the raw material. This can be investigated theoretically first by simulations, to verify the validity of the process flowsheet.

Another important motivation behind this project was aimed towards analyzing usage of Open Source process simulation software DWSIM as compared to the normal licensed softwares such ASPEN which is one of the most preferred softwares for such applications in the industry. The software licensing costs are quite high and using open source software could considerably decrease these expenses which are significant towards developing chemical plants. To comprehend the level of reliability and versatility of open source softwares, one good way would be to simulate existing plants demonstrating the same using them.

Thus, need for improvement for getting better profits as well as to analyze and comprehend the robustness of open source software DWSIM makes the project a good thing to work upon.

SPECIFICATIONS PERTAINING TO THE PLANT

The natural gas processing plant has the following process flow diagram:



Some of the important stream specifications in the above process flowsheet are as follows:

Line	Pressure(Kg/cm²)	Temperature(degree C)
A1	54.5	35
A2	54.3	25
H1	53.7	24
H2	53.2	-30
J1	27.7	16
J2	28	-75
Q1	53.1	-30
Q2	18	-75
N	13	65
I1	53	18
I2	53.2	-30

Feed Input Composition (Mole fractions)**:**

Methane	0.86048371
Ethane	0.05636618
Propane	0.034579252
Isobutane	0
N-butane	0.015690586
Isopentane	0.0022986208
N-pentane	0.0022986208
N-hexane	0.0033979612
N-heptane	0
Nitrogen	0.0024985009
Carbon dioxide	0.022386568

SIMULATION DATA ASSUMPTIONS

All the data pertaining to the process were input at the required place. The following assumptions were taken:

- The input raw material has zero water vapour. This was assumed to remove dryer as a component in the flowsheet as water would not affect any process ahead and adding a complex component like dryer is difficult in DWSIM
- The heat integration and energy integration implemented in the chiller as well as the compressor-expander system was not done as efficiency of its working is not known. Since, we knew the parameters of input and output streams of these sections, we are able to take the streams ahead for further processing in the software.
- 4 Chiller streams are provided as per need but separately and not in one common unit for simplicity purposes.product stream specifications

PRODUCT SPECIFICATIONS

Lean Gas (Mass Fraction):

Methane	0.83258017
Ethane	0.087405275
Propane	0.015442956
Isobutane	0
N-butane	0.00089690861
Isopentane	1.9682182E-05
N-pentane	1.3198328E-05

N-hexane	6.1606163E-07
N-heptane	0
Nitrogen	0.0042213608
Carbon dioxide	0.059419829

Naphtha (Mass Fraction):

Methane	0
Ethane	8.1568604E-20
Propane	2.1891848E-09
Isobutane	0
N-butane	0.069043577
Isopentane	0.14095537
N-pentane	0.18069288
N-hexane	0.60930817
N-heptane	0
Nitrogen	1.1060277E-23
Carbon dioxide	5.6479131E-25

Pentane (Mass Fraction):

Methane	4.2625347E-21
Ethane	6.9654106E-13
Propane	1.4719056E-06
Isobutane	0
N-butane	0.58352189
Isopentane	0.22631605
N-pentane	0.18329339
N-hexane	0.0068671988
N-heptane	0
Nitrogen	4.5067768E-20
Carbon dioxide	7.4324689E-21

LPG (Mass Fraction):

Methane	1.1680957E-11
Ethane	0.11300693
Propane	0.58358163
Isobutane	0

N-butane	0.30338512
Isopentane	1.7165334E-05
N-pentane	8.784809E-06
N-hexane	3.8808489E-12
N-heptane	0
Nitrogen	1.015052E-20
Carbon dioxide	3.7099173E-07

[IS-4576 standards requires 50:50 C3:C4 weight ratio requirement]

The actual data is tough to obtain for others as the specifications of the others would change as the feed to the plant varies. However, the LPG standards need to remain the same.

CONCLUSIONS

The product specifications are close to the ones the plant gives as an output. The irregularities in the data are due to unaccounted inefficiencies of the various components. The most important product, LPG has primarily C3, C4 in its stream as was expected in the complete process.

The successful and quite accurate simulation of the complete project implies that the open source software DWSIM could be a reliable software for simulations of plants like Natural Gas Processing unit at GAIL, Gandhar. The software has diverse nature to simulate complex separation processes. Though, the robustness of it in case of inclusion of chemical reactions in the process is yet to be explored.

The existing simulation can now be further used to try out various iterations to optimize the output flows as per theory results. Thus, this works as a miniature safe version of the complete plant to try out before one actually tries some variations in the real plant, which could cost millions if the results go wrong.