Petroleum & Coal
ISSN 1337-7027

Available online at www.vurup.sk/pc
Petroleum & Coal 49 (1), 67-71, 2007

STUDYING OF THE EFFECTIVENESS PARAMETERS FOR CONDENSATE STABILIZATION

A.Khanmohammadi*, Kh.Mohammadbeigy

Research Institute of Petroleum Industry – Tehran – Iran – P.O. Box 18745-4163, Phone: +98(21) 55901021-51 (Ext. 5431),Fax: +98 (21) 55931440, e-mail: Khanmohamadia@ripi.ir

Received February 7, 2007; accepted June 25, 2007

Abstract:
The consumers of condensate require a stable and sweet product and the gasoline produced by modern plant processes must meet established pipeline and marketing standards. In this paper are investigated effectiveness parameters on condensate stabilization process to reach standard specifications
The results are showed the operating pressure is a key parameter to satisfy required RVP (Reid vapor pressure) of product that it must be selected based on feed condition and process condition.
Reduction of waste hydrocarbon produced has an important role to select stabilization unit configuration so in this paper perform some case studies on two possible configuration of stabilization process.

Keywords: *Reid Vapor Pressure, Hydrocarbon, Waste Minimization*

1. Introduction

Stabilization of condensate refers to the stripping of the light ends content (methane - ethane) from the raw liquids and the removal of all acidic constituents to produce a suitable product for the market.

The Reid vapor pressure (RVP) of gasoline is regulated by environmental standard. The higher the RVP, the more quickly the gasoline will vaporize into the air. Therefore, when the weather temperature increases, it must be used gasoline with lower RVP.

The Stabilization operations involved are simple and the principles are similar to the ones used in LPG fractionation systems. In general, condensate stabilization accomplishes several goals, the foremost of which are:

- To increase the recovery of methane-ethane and LPG products.
- To lower the vapor pressure of the condensate, therefore making it more suitable for blending and reducing the evaporation losses while the product is in storage or shipment.
- To sweeten the raw liquids entering the plant by removing the hydrogen sulphide and carbon dioxide contents, in order to meet the required specifications.
- To maintain the purity and molecular weight of the lean absorption oil, free of certain components like pentanes and heavier hydrocarbons.

The removal of the methane, ethane, and propane from the stream and the reduction of butane content increase the production of sales gas, as shown in Table 1.

In addition, stabilization reduces the vapor pressure of the finished condensate and makes it suitable for storage, blending and transportation purposes. Moreover, it sweetens the raw liquids entering the plant by removing the hydrogen sulphide and carbon dioxide contents. Further, since the stabilization flash drum receives large volumes of heavier hydrocarbons as feed from the glycol separator, it helps to maintain the purity and molecular weight of the lean absorption oil as designed.

* Corresponding author

Table (I): Components in Natural Gasoline Before and After Stabilization

Components	Before Stabilization Mole%	Stabilizer Bottoms Mole%	Stabilizer Overhead Mole%
Methane	25	--	42.7
Ethane	10	--	14.8
Propane	24	0.2	41.5
Butane	18	41.7	1.0
Pentane	11	27.6	--
Hexane Plus	12	30.5	--

The finished product withdrawn from the bottom of the stabilizer is a liquid, different from that obtained by the distillation of crude oil or other refinery processes.

Natural gasoline is mainly used as a blending component to increase the volatility in motor fuels, particularly in colder weather. The field of aviation is also making demands on natural gasoline because of the excellent octane characteristics of the product. At an RVP of 234 kPa absolute, natural gasoline has an octane range from 46 to 72. Most stabilized gasolines, however, are produced with an RVP of 28 to 69 kPa absolute. Stabilization of condensate streams can be accomplished through either flash vaporization or fractionation.

2. Simulation and Case study

The stabilization unit is simulated to investigate effectiveness of process variable on unit condition. Table (I) is shown the feed specification based on standard condition. In this study, The Reid vapor pressure (RVP) of product must be reach to 10, 12 psia in summer and winter, repressively.

Table (2): Feed Specification

Cut Point [%]	TBP [C]	ASTM D86 [C]	ASTM D1160 (Atm) [C]	ASTM D2887 [C]
5	39.4	68.0	52.8	21.3
10	53.3	78.6	64.7	48.1
15	66.9	89.0	76.7	61.2
25	91.0	107.7	98.5	87.0
40	129.9	137.4	133.3	127.6
45	142.1	146.7	143.7	139.0
60	176.3	175.0	176.3	175.7
70	211.9	207.1	211.9	205.8
85	271.7	264.4	271.7	272.2
90	308.0	297.5	308.0	308.3
95	341.5	324.7	341.5	344.7

It is studied various configurations for stabilization unit, which they illustrated in the figure (1) and (2). In configuration.1 is considered two stages separation to stabilize condensate first stage separator (RVP Stabilizer Vessel) has certain operating pressure condition about 90 kPa at all conditions for satisfying of RVP margin (10 Psia) and stabilized product is sent from bottom of first stage to storage tank. Low-pressure conditions in first stage are created by vacuum pump. Second stage separator (Recovery Vessel) has upper pressure than first stage separator for recovery of some heavy cuts that carried by suction of vacuum pump, entrainment and or solute in lights cuts because of thermodynamic equilibrium that exist in first stage separator conditions. Cooler can have advantage in recovery of second stage separator by condensing of heavy cuts.

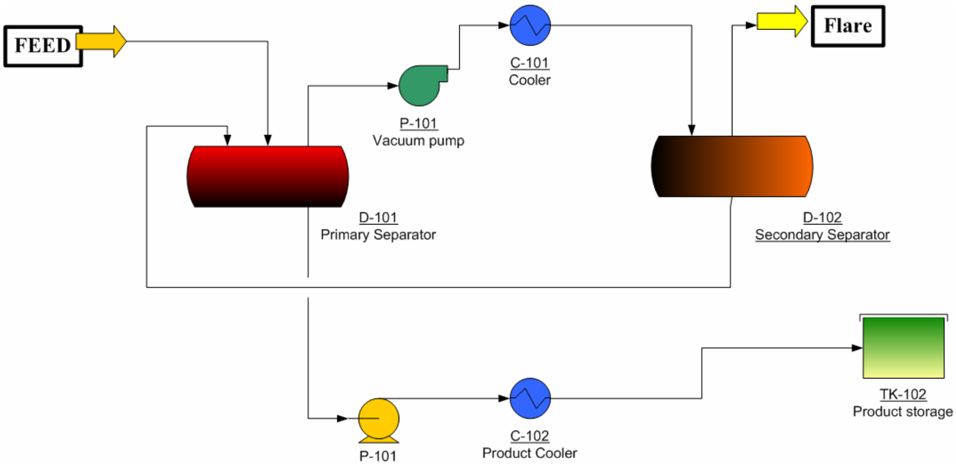

Fig (1): The schematic of gasoline stabilization unit (vacuum pump after 1st separator stage)

The consequent of RVP Stabilizer Vessel and Recovery Vessel are different in configuration.2. In this configuration, first stage is used for recovery and second stage is used for setting of product RVP. In despite of configuration.1, the vacuum pump is used after second stage separator and so second stage worked in fixed operating pressure about 90 kPa. Second stage separator has lower pressure than first stage separator and product is sent to storage tank from second stage. The pressure vessel sequence in configuration.2 is similar to the production unit of wellhead surface facilities.

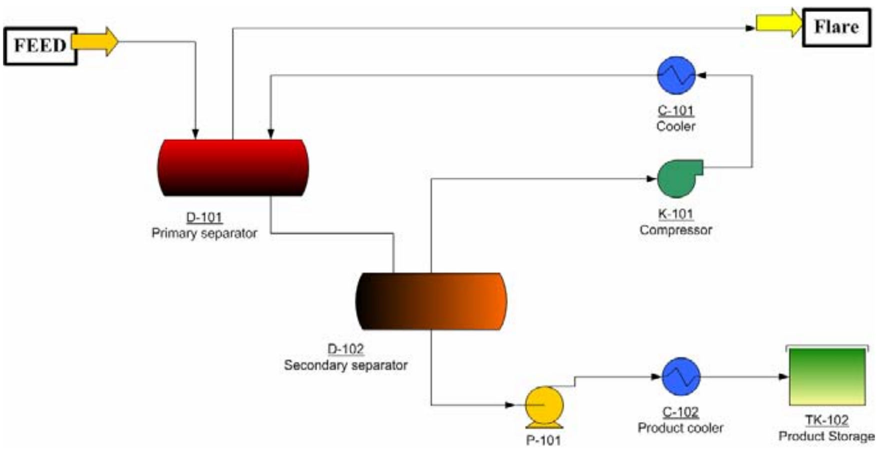

Fig (2): The schematic of gasoline stabilization unit (vacuum pump after second separator stage)

Figure (3) is shown the waste content that it is sent to flare and required power versus pressure of second separator. The first stage pressure is considered constant (90 kPa). When the pressure of second stage increase; the waste content decrease but the required power will be increase, therefore it causes to increase operating cost.

In figure (4) is drawn Product RVP versus pressure of second separator. The required RVP in summer case is 10 psia.

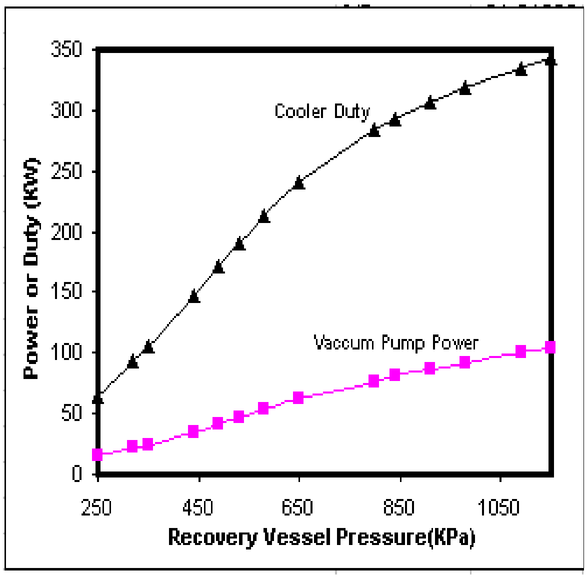

Figure (3): Utility variation in configuration 1 versus pressure of recovery vessel.

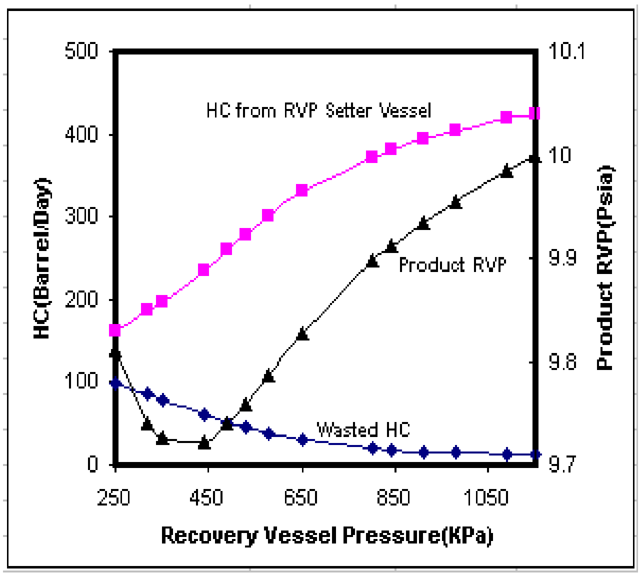

Figure (4): Product RVP versus pressure of secondary separator (configuration 1)

It's performed the similar case study for second configuration (case B). The figure 5 and 6 illustrate simulation result.

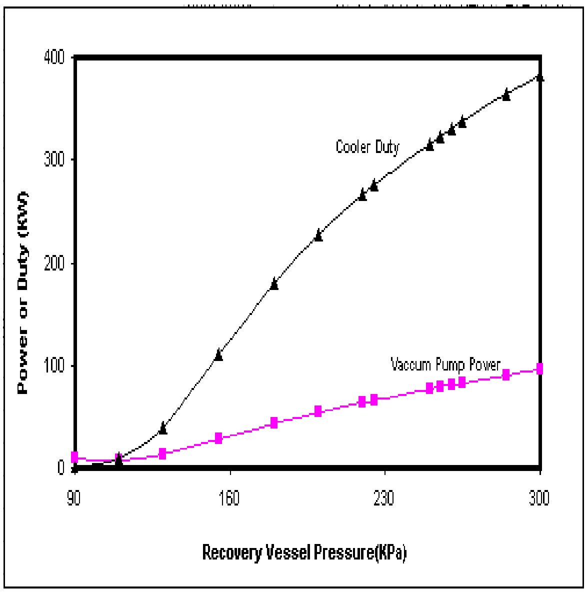

Figure (5): Utility variation in configuration 2 versus pressure of secondary separator

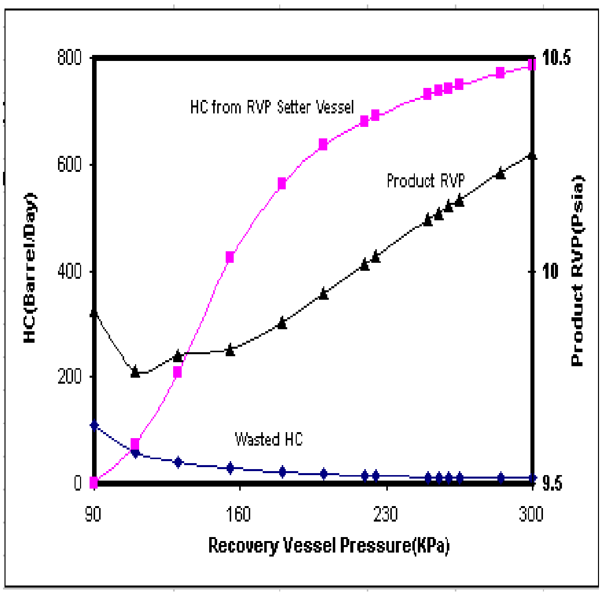

Figure (6): Product RVP versus pressure of secondary separator (configuration 2)

The total objective function is defined as fallowing equation:

$$F_T = \omega_W \times F_W + \omega_P \times F_P + \omega_C \times F_C + \omega_I \times F_I \quad (1)$$

Where F_W, F_P, F_C and F_I are wasted hydrocarbon price, power cost, cooling utility cost and investment coat, respectively. The weight factors ω_W, ω_P, ω_C, and ω_I above function are used to reflect relative costs. It investigated the effect of pressure variation on objective function, for this reason, the operating pressure is changed from 220Kpa to 1400 kPa. The figure (7) illustrates investment cost versus system pressure

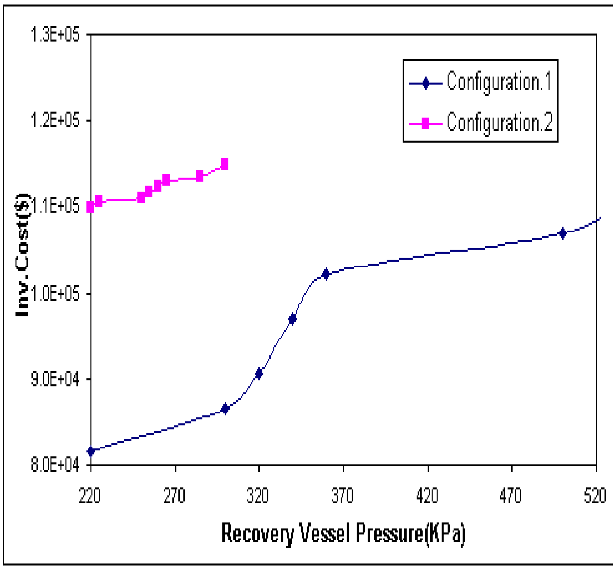

Figure (7): Investment cost variation versus pressure change of recovery vessel.

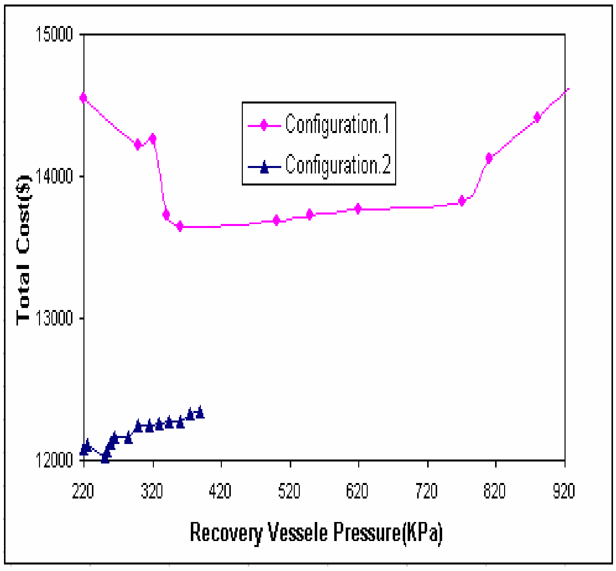

Figure (8): Total cost variation versus pressure change of recovery vessel.

The objective function (total cost) variation is shown in figure (8) for both of configurations. The optimum condition of configuration.2 is less than configuration.1.

3. Conclusions

The control of operating condition is important in condensate stabilization unit. The suitable configuration must be selected based on feed condition and required product specification. According the obtained result, configuration No.2 is suitable choice in most condition, which has lower capital cost and higher hydrocarbon recovery. But as the configuration No.2 can be operated at lower pressure then it has better flexibility and system control. The total cost of configuration.2 is less than configuration.1 in all feasible regions but configuration.2 cannot satisfy RVP margin in higher pressure and then its hydrocarbon recovery is more limited than configuration.1. The Maximum hydrocarbon recovery for configuration.2 is about 70% more than configuration.2 so configuration.1 is more suitable in the situation that the hydrocarbon recovery is most important than other parameters. But in same operating conditions the recovery of configuration.2 is about (4-5) times more than configuration.1. If the capacity of feed and its volatile components content be higher the configuration 2. The sensitive of configuration 2 to pressure change is more than configuration 1.

References

[1] K. Arnold, M. Stewart , Surface production operations, Gulf Professional Publishing, Second edition, 1998.

[2] A. Maleq, S. Farooq, Determination of Equilibrium Isotherms Using Dynamic Column Breakthrough and Constant Flow Equilibrium Desorption, J. Chem. Eng. Data, Vol.40, No.25, 1995.

[3] D.M Ruthven, Principles of Adsorption & Adsorption Processes, John Wiley & Sons, 1984.

[4] N.A. Baramygina, A.V. Kravtsov, Simulation of stabilization gas condensate process, 8th Korea-Russia International Symposium on Science and Technology - Proceedings: KORUS 2004, 2004, p 15-16.