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Features of Vessels Exploitation for Intermediate Storage of Propane-Butane Fraction

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ABSTRACT: At gas processing plant (GPP) installations of high unit capacity and technological environments with high corrosion activity are used. Object of researches are vessels of storage of propane-butane fraction (PBF) of type PS-100, PS-200 on condensate stabilization installation (CSI).

KEY WORDS: aggression of environment, equipment metal, hydrogen sulfide, carbonic gas, sulfur, highly mineralized formation water.

I.INTRODUCTION

At gas processing plant (GPP) installations of high unit capacity and technological environments with high corrosion activity are used. The duration of their distance run between overhauls defined on a category of manufactures, - one time within 12 months. However because of equipment steel corrosion off-schedule repair) stops occur and, as consequence, losses of raw materials, metal and finished goods. Now the corrosion problem in gas processing plant system is aggravated by sharp ageing of the main metal fund, premature failure of vessels as a result of aggressive components influences in working environments. In this plan the major scientific, technical and economic problem consists in prolonging term of accident-free equipment exploitation in the enterprises, in particular, of the vessels exploitive under the pressure of [1-3].

On the basis of results of vessels MGPP inspection it is established, that at their operation in excited environment carbonaceous and low alloy steel are exposed to stratification. It is observed in various kinds of the equipment: capacities, columns, gas separators, made basically from steel of marks ВСт 3 сп (kp, ps), 16ГС, 09Г2С. The given kind of destruction is the most dangerous and leads to accidents with the maximal adverse technical, ecological and economic consequences [4].

For increase of reliability and increase in service life, protection of the equipment against corrosion in especially aggressive conditions, at processing gas and gas condensates containing hydrogen sulfide or sulfur-organic compound with low thermostability - (<130°C), and also up to 1800 mg/l of salts, it is recommended to spend corrosion-resistant alloying, heat treatment, apply various coverings, inhibitors and lubricants, and also use electrochemical protection [5].

For protection against general corrosion in hydrosulfuric environments of the equipment from carbonaceous steel and maintenance of its acceptable durability it is possible also by increase effective thickness of walls. However this way does not prevent cracking of metal which represents much greater danger. At increase in durability of steel the probability of destruction on grain boundaries increases. With growth of a limit of fluidity from 725 up to 1210 MPa character of destruction in the environment of hydrogen sulfide at partial pressure from 0,13 up to 0,44 MPa varies from transcrystalline up to intercrystalline.

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II. OBJECT OF RESEARCH

Object of researches are vessels of storage of propane-butane fraction (PBF) of type PS-100, PS-200 on condensate stabilization installation (CSI) (fig. 1). The attention to such storage vessels is caused by that as a result of their planned inspection, basically - on internal surface sites of metal stratification (hydrogenation) of the equipment with swelling formation are found out (fig. 2). The purpose of researches is definition of exploitation condition and the reasons of corrosive failures of vessels for storage PBF.

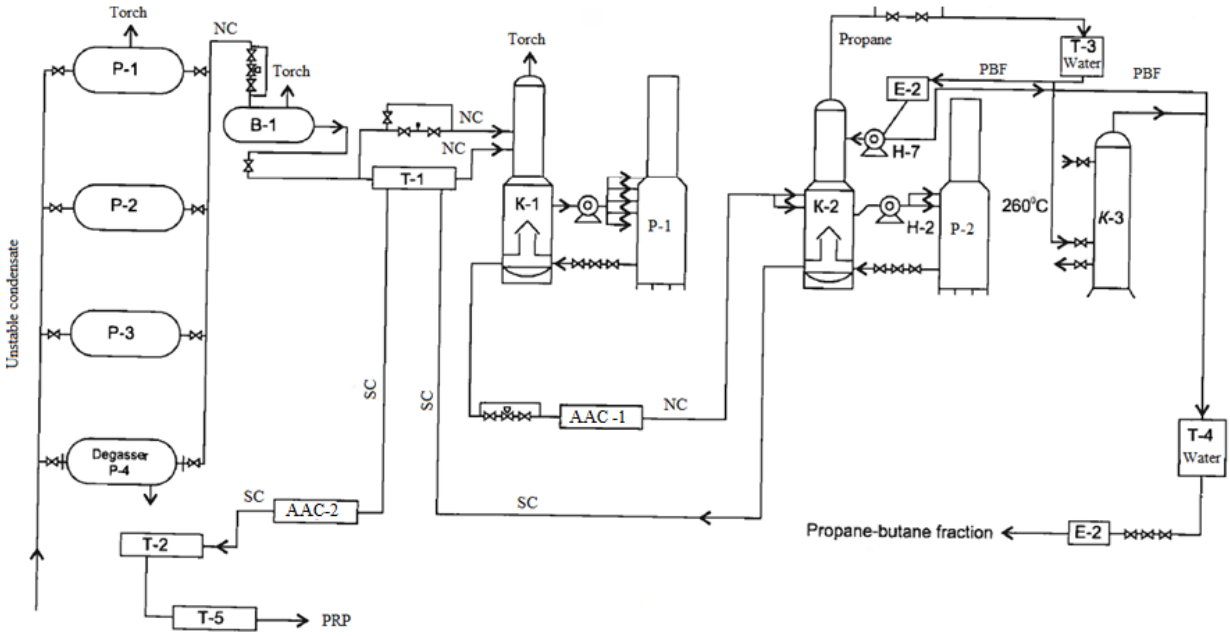

Fig. 1.Scheme of condensate stabilization unit

Following aspects were thus considered: aggression of environment, technology of filling and vessels emptying, a condition of equipment metal. The analysis of received results has laid down in basis of working out recommendations on improvement of corrosive condition of, vessels.

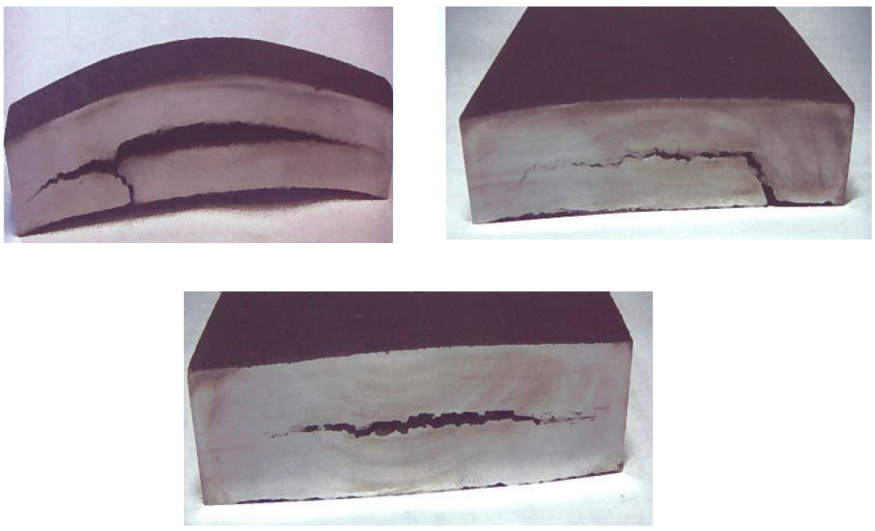

Fig. 2. Sections of bulging and stratifications in vessels walls for intermediate storage of PBF

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Operation of CSI provides allocation from gas condensate of light hydrocarbons C_1-C_4, reception of liquefied gas -PBF and a stable gas condensate from partially decontaminated unstable condensate arriving from fields of USE «Mubarekneftgaz». Installation consists of three in parallel working identical technological threads by potential output 263,8 thousand t per year of unstable condensate each.
Partially decontaminated unstable condensate and gas arriving for processing contain accompanying corrosion -active impurities: hydrogen sulfide, carbonic gas, sulfur, highly mineralized formation water.

III.RESEARCH PART

Stratification of equipment metal is revealed on internal surface in 6 of 11 vessels intended for storage of PBF after 1 - 3,7 years of operation though term of their accident-free operation makes an order of 12 years [6, 7]. As a result of spent flaw detection researches it was found out[8]:
- Superficial defects in number of 20 by diameter from 15 to250 mm and depth up to 11,4 mm;
- Defects in the basic metal of heat-affected zones of stratification type and cracking.
It is defined, that vessels are in disabled condition [9, 10] in view of infringement of integrity of metal weight which reasons can be:
- Aggression of working environment with excess content of hydrogen sulphide getting during the period of absorber K-3stop in the process of fractionating of gases;
- Water condensation on all internal surfaces of a vessel at the expense of high pressure;
- Presence of considerable quantity of nonmetallic impurities in steel;
- Low corrosion resistance of vessels steel in relation to aggressive working environments.

IV.CONCLUSION

Results of the spent complex researches have shown, that considerable quantity of the hydrogen sulphide at fractionating disappears from initial gas with light (top) products of the first rectifying two columns, for which the highest pressure [6, 7] is characteristic (on technological thread). It is obvious, that pressure promotes increase in, solubility of hydrogen sulphide from gas phase into water with creation steady even at high temperatures of the system [9-11].
The analysis of technological processes has shown that favorable conditions of moisture condensation are created duringstart-up and equipment stops at high pressure in devices for liquefied propane, and also at increase in partial pressure and quantities of hydrogen sulphide in no aqueous phase that promotes more solubility of hydrogen sulphide indrainage water.
The form, composition and properties of nonmetallic inclusions essentially influence on hydrogen cracking of steels. During tempering thermal internal stresses arise on phase boundary between steel and such inclusions, as silicon oxides and aluminum, having low coefficient of thermal expansion (CTE). Near the sulphides characterized by large CTE and weak communication with a matrix, during cooling there is no stress field, and empty areas appearthere - collectors of gaseous hydrogen. Pattern streakiness raises propensity to hydrogen cracking [12,13].
Micro researches have shown, that fragments metal of tested vessels is thermally processed, as has structure of low-carbon sorbite. In the crack (result of stratification) are found out inclusions of sulphides. On unetched thin sections nonmetallic inclusions - dot oxides- are well looked through. By their quantity and an arrangement along all area of fibers with longitudinal direction by comparison to reference scales an impurity of microsections by nonmetallic inclusions can be carried to the fifth point on five-ball scale (oxides content should not exceed 0,5 points) [12,13].
For metals of iron group immediate presence of hydrogensulphide and nonmetallic inclusions (enough considerable quantity) initiates and accelerates course both of cathode and anode processes stimulating hydrogenation as a rest of it on investigated fragments of tested vessels there are swellings (stratification).
The spent engineering-research works have shown that parameters of technical vessel condition for intermediate storage of PBF not fit requirements of the operating standard documentation, i.e. they are in no serviceability in view of infringement of metal weight integrity (cracking, stratification) which reasons are:
- Aggression of working environment with excess content of the hydrogen sulphide getting during the period i absorber K-3 stop in process of gases fractionating from initial gas together with skims (propane), and also water condensation on all internal surface of a vessel at the expense of high pressure;

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- Favorable conditions of moisture condensation during start-up and equipment stops, at high pressures in device for liquefied propane, and also increase in partial pressure of hydrogen sulphide in no aqueous phase that promotes more of hydrogen sulphide solubility in drainage water;
- Presence of increased from GOST 1778 requirements quantities of nonmetallic inclusions.

Following recommendations are developed for prevention of corrosion processes in vessels for intermediate storage of liquefied propane:

- In order to reduce aggression and humidity of PBF, and also pressure in vessels it is expedient to make an exhaust PBF from vessels E-2/1,2,3 instead of over pressing by cleared gas on CSI by pump equipment on vessels E- 1/1,2,4,5 near rail park (RP);
- For reduction of hydrogen sulphide content in composition of PBF, start up CSI in work of absorber K-3;
- For prevention of moisture ingress in vessels testing tightness of technological threads and heat exchangers necessary as well as optimization of temperature of top column K-2;
- With an aim of further removal of water through existing tanks establish a drainage line for water drain from vessels E-2/1,2,3 into emergency capacities E-4/1,2;
- For moisture catching between heat exchanger T-4 capacity E-2/3,4 establish an intermediate separator -moisture separator OV-1.

At formation of requirements to vessels material for intermediate storage PBF (and other production which corrosive medium) an application of the metal which was use (especially petrol-or gas pipes) should be forbidden and also toughen requirements to quantity of nonmetallic inclusions [13]:

- For sulphides≤1,0 points;
- For nitrides ≤ 1,0 points;
- For stitch oxides -0,5 points;
- For large silicates ≤ 2,5 points;
- For silicates not deformed ≤ 3,0 points.

For the purpose of maintenance of longer term of ace dent-free operation of vessels:

- It is expedient to consider a possibility of replacement of steel mark of vessels applied for today on 20 UCh, and also introductions of requirements on optimization of nonmetallic impurities presence and rolled metal uniformity of «class 0» in Performance specification on manufacturing of vessels of type PS-100, PS-200 for operation in technological conditions of MGPP [14];
- To spend 100 %- entrance control by methods VICK and UZK of new bought vessels with results recording to their passport.

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