IRESEARCH ON THE CORROSION OF CONSTRUCTION MATERIALS FISSURE MACHINERY HYDROCARBONS IN CONTAMINATED ENVIRONMENTS WITH STAFF FROM CORROSIVE BY CRUDE OIL DISTILATION

Moroşanu Marius [1], Ovidiu Georgescu[2]

[1]*marius.morosanu2003@gmail.com.*

Abstract: In the atmospheric distillation of crude oil facilities and in vacuum of the fuel oil were highlighted in uniform and uneven general corrosion, local corrosion in the form of points, spots, caves and cracking, selective, crevice, etc. .. All these forms of corrosion are dangerons, corrosion cracking, however, occupies a special place, because in a short time can switches off the machine or plant with hard consequences sometimes to assess. If sulfur crude oil processing appeared to corrosion cracking of austenitic stainless steel scales of DA-C1 column at the top, after 1.5 years of operation. Also, heat exchangers at the top of the columns DA and DV, with monel or carbon steel pipe. Hydrocarbon environments in the presence of additional factors, are potentially active for the emergence and development of corrosion cracking. The paper presents some aspects of metal corrosion crack to metal equipments in the crude oil distillation plants and fuel oil vacuum

Keywords: *stress corrosion, load test, time fractional (max. 5)*

1. Aims and background

Corrosion cracking under stress is one of the most dangerous forms, given the destruction that it causes to metal materials used in manufacturing industrial machinery. This process is manifested by intergranular cracking and transgranular, accompanied by a reduction in strength properties and finally, the fracture mechanics of materials in the cracks.

Environments containing hydrochloric acid, hydrogen sulfide, naphthenic acids, cyanides, etc.. are specific environments that cause cracking and ultimately fracture of steels subjected to corrosion cracking under stress in the normal operation of the plant from atmospheric distillation of crude oil and fuel oil vacuum. Sulfur compounds, chlorine, nitrogen and oxygen are converted to hydrogen sulphide, hydrochloric acid, ammonia and respectively water [1-3].

The compounds of conversion in the absence of corrosion inhibitors have a corrosive action on metal equipment from carbon steel, stainless steel or alloys CuZn, Cu Ni, itself and their interaction products (ammonium chloride, ammonium sulfide, ferric chloride, etc..). These building materials in specific environment conditions, are susceptible to corrosion cracking - [4-6].

2. Experimental

The paper presents experimental data obtained from tests performed by the conventional method of determining the time of failure and the propagation of cracks in the corrosion of metal materials.

Materials used are carbon steel S235JR , stainless ferrites steel 7AlCr130 and austenitic stainless steels X6CrNiTi 18-10 and 17-12-2 X6CrNiMoTi of high mechanical strength, whose composition is shown in **Table 2.1.**

Tabel 2.1.- Chemical composition of studied steel

Steel	Components , %							
	C	Mn	Si	Cr	Ni	Ti	Mo	P	S
S235JR	0,18	0,53	0,30	-	-	-	-	0,04	0,04
X6CrAl 13	0,08	0,60	0,60	13,2	-	0,1	-	0,03	0,015
X6CrNiTi 18-10	0,06	1,8	0,7	18,5	9,5	0,51	-	0,03	0,014
X6CrNiMoTi 17-12-2	0,07	1,7	0,8	18,3	11,2	0,52	2,4	0,04	0,015

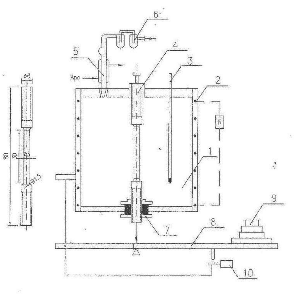
Also, test samples were stabilized brass (70% Cu, 29% Zn, 1% Sn) and Monel W2.4230 (65.9% Ni, 32.5% Cu, 0.03% Al, 1, 57% Fe).

The specimens used in corrosion cracking tests are of cylindrical shape with a diameter of 3 mm, threaded at both ends to be caught in fast-tensioning device to ECO Before each determination, the metal specimens were machined and polished with metallographic paper to 600 grit, then degreased in acetone.

Tensioning specimens was performed under a constant load voltage to a unidirectional, its value to 50%, 70% and 85% of breaking strength of the material tested.

Tests were conducted at temperature of 200C in condensate aqueous collected from the top of the atmospheric distillation column column AD-C1-C5 VD vacuum distillation, samples weher pH was maintained in the 6.0 to 6.5 and the chloride content was 30-60 ppm.

The samples tested were mounted in the container unit composition aggressive environment. Lever was loaded with weights until the tensioning force of the specimen (**Figure 2. 1**). Test time is measured by timer with digital readout, and the cracking sound samples is reported. The timer stops to the break, if the sample and indicate the number of hours during the sample remains under load.



1– cell solution;

2 – heating jacket;

3 – thermometer

4 – corrosion specimen;

5 – refrigerant;

6 – hydraulic closure;

7 – sealing;

8 – lever;

9 – greutăți;

10 – dispozitiv de semnalizare a ruperii.

Figure.2.1: *Divice for determining a corrosion crack with unidirectional voltage*

Also, the tendency to corrosion cracking of steels investigated was determined according to SR **SR ISO 7539-2:1994/A99:2002**. The method involves immersing for a specified duration of epruvette, previously deformed in cold and tense elastic device shown in **Figure 2.2**

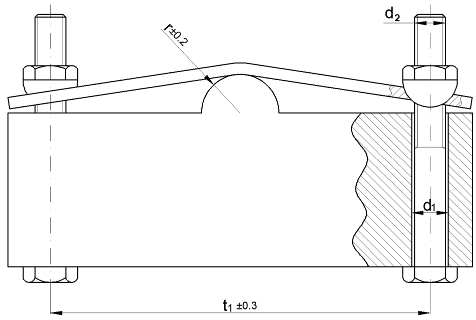


Figure. 2.2 : Sample tensioning device

Test environments at the top of the columns were maintained at 80 temperature and the continuous refluxing and extensive examination of the specimen surface was made after its removal from solution. The samples were processed only to the interior, which comes into contact with the mandrel. The specimens were mounted in the device so that the processed surface to be placed in the compression and tension by tightening the screws Co up to a distance of 2 mm between the specimen cap and base plate of the device. Specimens caught in the device tensions were degreased with acetone and were placed in a corrosive environment, which should completely cover the specimens, the duration of the test.

The specimens were examined visually for cracks control. The examination was conducted by taking samples of the solution, washing with hot distilled water and observing with the naked eye and with a 10x zoom lens.

3 Results and discussion

Composition of condensate aqueous collected from the top of the atmospheric crude distillation column AD-C1 (**Figure 3.1**) and vacuum distillation of fuel oil VD-C5 (**Figure 3.2**) are presented in **Table 3.1**, and stress corrosion cracking test results are presented in **table 3.2.**

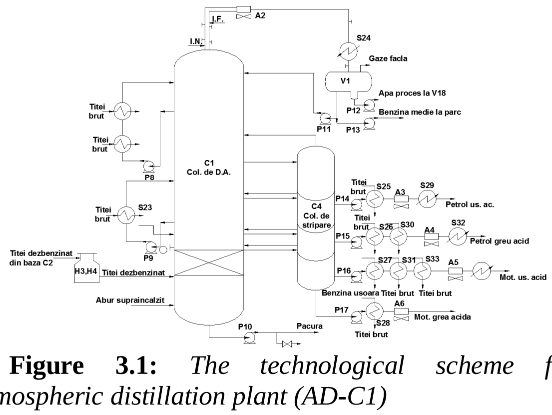


Figure 3.1: *The technological scheme for atmospheric distillation plant (AD-C1)*

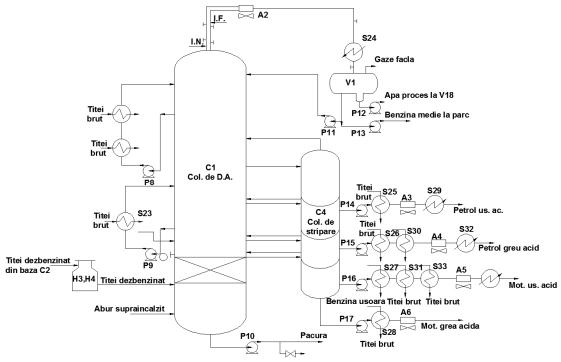


Fig. 3.2: *The technological scheme for vid distillation plant (VD-C5)*

Table 3.1 *Quality of aqueous condensate test*

No	Qualitative Characteristics	UM	Working place	
			Column reflux tank AD-V1	Colum reflux recipient Dv-V100
1	pH	upH	6,4	6,7
2	Chlorides	ppm	42	31
3	Sulfur	ppm	52	45
4	Iron	ppm	0,1	0,2

Table 3.2: *Values for fracture time of the tested materials at temperatures of 200C and 800C in the alquons condensate from the top of the column AD-C1, pH=6,0*

It appears that after 1000 hours of testing in the aqueous condensate from the top of the column AD-C1 did not show cracks on the surface of specimens under unidirectional tension of 50% of the breaking strength of the material. At test loads of 85% from the tensile strength, fracture time decreased. This decrease becomes more pronounced by increasing the operating temperature of 200C to 800C.

Also tested were the same types of materials into the tension that in Figure 1. Lack of large cracks on the (upper) of the specimen showed resistance to corrosion cracking under stress of the tested materials (**Table 3.3**).

Specimens of carbon steel S235JR had corrosion rates of 0.118 mm / year at the top of the column DA-C1 and 0.130 mm / year at the top of the column C5 DV-corrosion showed punctuate on the whole surface. Austenitic stainless steels have much lower corrosion rates and their surface is uniform general corrosion. Furthermore, brass CuZn 28 and Monel W24230 SN1 have corrosion rates of 0,012 mm / year respectively 0.0103 mm / year.

No	Material	Breaking results Rm N/mm2	% from Rm N/mm2	Tasktest N/mm2	Temperatures 0C	For Facture time	Observation
1	S235JR	420	50	210	20	>1000	Nu s-a rupt
					80	>1000	Nu s-a rupt
			70	294	20	>1000	Nu s-a rupt
					80	750	S-a rupt
			85	357	20	390	S-a rupt
					80	105	S-a rupt
2	X6CrAl13	560	70	392	20	>1000	Nu s-a rupt
					80	>1000	Nu s-a rupt
3	X6CrNiTi 18-10	550	50	275	20	>1000	Nu s-a rupt
					80	>1000	Nu s-a rupt
			70	385	20	>1000	Nu s-a rupt
					80	>1000	Nu s-a rupt
			85	467.5	20	>1000	Nu s-a rupt
					80	>1000	Nu s-a rupt
4	X6CrNiMoTi17-12-2	540	50	275	20	>1000	Nu s-a rupt
					80	>1000	Nu s-a rupt
			70	385	20	>1000	Nu s-a rupt
					80	>1000	Nu s-a rupt
			85	467.5	20	>1000	Nu s-a rupt
					80	>1000	Nu s-a rupt
5	Brass	350	70	245	20	>1000	Nu s-a rupt
					80	>1000	Nu s-a rupt
6	Monel	580	70	406	20	>1000	Nu s-a rupt
					80	>1000	Nu s-a rupt

Tabel 3.3: *Test results of the tested materials corrosion cracking at 80 temperature for 96 hours*

No	Work Environment	Nature Materials	Time to break after 140 hours	The corrosion rate	
				Kg, g/m2 h	P, mm/an
1	Condensation from the top of distillation column AD-C1	S235JR	No cracks	0,107	0,118
		X6CrAl13	No cracks	0,022	0,024
		X6CrNiTi 18-10	No cracks	0,014	0,016
		X6CrNiMoTi 17-12-2	No cracks	0,0044	0,0049
		Brass	No cracks	0,011	0,012
		Monel	No cracks	0,0093	0,0203
2	Condensation from the top of distillation column VD-C5	S235JR	No cracks	0,12	0,13
		X6CrAl13	No cracks	0,024	0,027
		X6CrNiTi 18-10	No cracks	0,019	0,021
		X6CrNiMoTi 17-12-2	No cracks	0,0052	0,0058

On visual inspection of samples there were not found am cracks. The values of corrosion rates ranged in the materials stability group metals. The data presented show that the methods used the studied materials fracturing time is high.

4 Conclusion

1. Corrosion cracking tests were performed with samples under a unidirectional tensin at a constant load and with samples deformed at cold and elastic tensied.

2. After 1000 hours of testing in the aqueous condensate from the top of the column DA-C1 did not show cracks on the surface of specimens under unidirectional tension of 50% and 70% of breaking strength and break more quickly specimens at a temperature of 800C.

3. By the cold deformation and elastic tension, the samples exposed in the media at the top of the column DA-C1-C5 DV, at boiling temperature, were not affected by cracks.

4. The presence of chloride with hydrogen sulfide accelerates corrosion phenomena, compared with the corrosions processed only by hydrogen sulfide. Hydrochloric acid aqueous solutions under high unit action efforts, cause corrosion cracking of austenitic stainless steels.

5. Low concentrations of chlorides, ppm order. produce austenitic cracks when water with salts is concentrated by boiling. The tendency to cracking increases with the temperature increasing at a constant voltage and with increasing salt content.

6. Variable-valence metal chlorides Fe2 + / Fe3 +, Cu2 + / Cu + give rise to pitting corrosion, which may constitue germs of corrosion cracking.

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