

# STUDY OF THE EFFECTS OF ACID DETERGENT WITH DIFFERENT CORROSION INHIBITORS ON THE STATE OF MILKING EQUIPMENT

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The study of corrosion effects of an experimental sample of the acid detergent with different corrosion inhibitors in its structure, in particular, ammonium nitrate, hexamine, hydroquinone, subtilisin for metals, from which the individual parts of milking equipment are manufactured. It is established that the introduction in the composition of the experimental sample means of ammonium nitrate helps to reduce the corrosive action on aluminum and stainless steel.

***Key words:*** *corrosion action, corrosion inhibitor, acid detergent, milk stone*

For the increasing of requirements to the quality of the milk that in modern conditions the important factor is to prevent hit in its microorganisms, including conditionally pathogenic and pathogenic [1, 2].

Microbiological indicators of the quality of milk depend, mainly, from the sanitary condition of the milking equipment. Studies [3] found that up to 80 % of the primary microflora milk is formed due to microflora of milking machines and dairy dishes.

In the process of operation of the milking equipment on its surface in contact with the milk, is being gradually formed ore-fatty pellicle. In the future it adsorbs mineral salts milk, water and alkaline detergents, this creates a different density milk stone, which is a place of the depositing of microorganisms [4]. In dairy farms to prevent formation of milk stone and its removal from the internal surfaces of milking equipment acid detergents are used [5, 6].

In addition to the removal and prevention education milk stone acid detergents should be of low corrosion actions. As a result of the corrosion properties of funds

sanitary processing is destroyed by the working surface of the dairy equipment, which leads to reduction of their economic use of milking equipment. Over the damaged surface of the accumulated balances of milk and conditions are created for the active microbial contamination [7], as a result of which disinfectant effect is considerably reduced. So actual now is the creation of acid detergents with low corrosion activity.

**The aim of our research** was to determine the optimum corrosion inhibitor in the experimental sample of the acid-detergent for the sanitary processing of milking equipment and milk cattle breeding.

**Materials and methods of research.** Degree of corrosion activity was studied in accordance with the methodological recommendations of the "Assessment of the suitability and efficiency of washing, disinfectant and washing-disinfectants for the sanitary processing of milking equipment and milk inventory" [8] and according to GOST 9.908-85 [9]. In the experiments samples of metals from which manufactured milking equipment and milk equipment farms aluminum, stainless and galvanized steel are used, the size of 50 x 20 mm and thickness from 1 up to 4 mm.

A glass jar was filled with solution in the concentration that is recommended for practical use, on the basis of 20 ml per each square centimeter square test record. Test-record was stuck in a loop of cord yarn production with tweezers, hung on to the glass wand and are immersed in solutions of the studied so that it does not touch the bottom and the walls of the vessel. For the control imported acid detergent San acid was used and his plate was ducked in the same way. Plates were incubated in solution at room temperature 182,5 hour. Exposure time in total amounted to an annual duration of the process of washing and disinfection of the milking equipment.

After the end of the exposure the plates were washed with running water, all surfaces were gently wiped with a cotton swab, which is pre-moistened with 5 % solution of nitric acid for the removal of corrosion products, then it was washed with distilled water and dried in a drying oven for 15 minutes at the temperature of 120 C. After the full cooling they were weighted with a precision of up to 0.0001 g.

**The results of the study.** In the experiment an experimental model of acid detergent without corrosion inhibitor option was used and in the structure of which the acetic acid - 10 %, citric acid - 20 %, distilled water 70 % and with corrosion inhibitors: the nitrate ammonium experienced variant II, urotropine - III, hydroquinone - IV, triethanolamine - V (table. 1).

### 1. Chemical composition of prototypes of acid detergent, %

Chemical substance	Option				
	I	II	III	IV	V
Nitric acid	10	10	10	10	10
Citric acid	20	20	20	20	20
Ammonium nitrate	–	5	–	–	–
Methylamine	–	–	5	–	–
Hydroquinone	–	–	–	5	
Triethanolamine	–	–	–	–	5
Distilled water	70	65	65	65	65

Results of a study of corrosive activity of the experimental samples of acid detergent to the metal from which manufactured the individual parts of milking machines and dairy equipment are given in the table. 2.

From the data table. 2 shows that the corrosion activity of 0.5 % of the solutions of the samples I, III and V of the options to the aluminium higher than the admissible norm (2 g/m<sup>2</sup>-year) to means which are intended for the sanitary processing of milking equipment and milk products. Samples of acid detergent II and IV options in such concentration had a low corrosion activity on aluminium. Experimental samples of II and IV options were corrosive in respect of foreign means of San acid respectively 9.9 and 53 times less.

**2. Corrosion activity of the solutions of an experimental variant of acid detergent on samples of metals from which manufactured milk equipment of farms,  $M \pm m$ ,  $n=30$**

Options	The concentration Of the sample, %	Weight of sample, $\Gamma$		The difference between the mass of sample, g	Size corrosion h/m <sup>2</sup> per year
		Initial	in 182,5 hours.		
<b>Aluminum</b>					
I	0,5	5,8488 $\pm$ 0,1987	5,8434 $\pm$ 0,1976	0,0054 $\pm$ 0,0011	2,7
II	0,5	5,7936 $\pm$ 0,1512	5,7905 $\pm$ 0,1511	0,0031 $\pm$ 0,0001	1,6
III	0,5	5,8261 $\pm$ 0,1352	5,8213 $\pm$ 0,1343	0,0048 $\pm$ 0,0004	2,4
IV	0,5	5,7834 $\pm$ 0,1342	5,7828 $\pm$ 0,1341	0,0006 $\pm$ 0,0001	0,3
V	0,5	5,6640 $\pm$ 0,2068	5,6589 $\pm$ 0,2065	0,0051 $\pm$ 0,0003	2,6
San acid	0,5	6,0622 $\pm$ 0,1352	6,0304 $\pm$ 0,1343	0,0318 $\pm$ 0,0009	15,9
<b>Galvanized steel</b>					
I	0,5	4,4519 $\pm$ 0,0961	4,3253 $\pm$ 0,0947	0,1266 $\pm$ 0,0014	63,3
II	0,5	4,3842 $\pm$ 0,1027	4,3166 $\pm$ 0,1023	0,0676 $\pm$ 0,0004	33,8
III	0,5	4,5626 $\pm$ 0,1182	4,4856 $\pm$ 0,1178	0,0770 $\pm$ 0,0004	38,5
IV	0,5	4,5216 $\pm$ 0,1182	4,3992 $\pm$ 0,1181	0,1224 $\pm$ 0,0024	61,2
V	0,5	4,4881 $\pm$ 0,0967	4,3669 $\pm$ 0,0959	0,1212 $\pm$ 0,0018	60,6
San acid	0,5	4,6554 $\pm$ 0,1352	4,5298 $\pm$ 0,1343	0,1256 $\pm$ 0,0009	62,8
<b>Stainless Steel</b>					
I	0,5	2,6307 $\pm$ 0,0564	2,6299 $\pm$ 0,0563	0,0008 $\pm$ 0,0001	0,5
II	0,5	2,6089 $\pm$ 0,0963	2,6088 $\pm$ 0,0962	0,0001 $\pm$ 0,0001	0,05
III	0,5	2,4741 $\pm$ 0,0904	2,4738 $\pm$ 0,0903	0,0003 $\pm$ 0,0001	0,15
IV	0,5	2,5342 $\pm$ 0,0672	2,5312 $\pm$ 0,0671	0,003 $\pm$ 0,0001	1,5
V	0,5	2,6242 $\pm$ 0,0564	2,6241 $\pm$ 0,0563	0,0001 $\pm$ 0,0001	0,05
San acid	0,5	2,5987 $\pm$ 0,0672	2,5984 $\pm$ 0,0671	0,0003 $\pm$ 0,0001	0,15

Corrosion activity of 0,5 % solutions of galvanized steel higher than the admissible norm by 30 times and more. The lowest it has been in the experimental variant II (1.9 times as compared with the means of San acid). This testifies to the unfitness of the solution for the washing of the dairy equipment, namely: buckets, which are made of galvanized steel.

Experimental samples of funds II and V options were less corrosion active for stainless steel. Their corrosive effect was smaller in comparison with the samples I, III, IV options and means of San acid in 5-30 times.

For further study an experimental model of option II was used, because he showed a low corrosive action in the investigated metals.

For determination of the effective concentration of the studied solutions of an experimental specimen means of variant II took collector of milking apparatus, in which the inner surface of the formed milk stone. It was found out, that for its destruction must be soaking collector in 0.5 %-s ' solution of experimental equipment for 15-20 min, with the subsequent mechanical removing it with a ruff.

Therefore, the received results of researches have shown, that the developed by us experimental sample of the acid means of a 0.5 % concentration weakens and destroys the milk stone, which gives grounds to pursue further its production research.

On the basis of the results of laboratory studies can be considered, that the use of the experimental sample means of variant II in the process of sanitary processing of milking equipment to ensure its proper sanitary condition.

## **Conclusions**

1. Introduction in the composition of acid detergent nitrate ammonium reduces the corrosion effect to the metal, in comparison with the means of San acid, which contains no corrosion inhibitors.

2. An experimental sample of the acid detergent was made, 0,5 %solution which shows low corrosive effect to the metal parts of milking equipment and milk equipment and weakens and destroys the milk stone.

3. It is necessary to search for other corrosion inhibitors to reduce the aggressiveness of acid detergents for galvanized steel.

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### **ВИВЧЕННЯ ДІЇ КИСЛОТНОГО МИЙНОГО ЗАСОБУ З РІЗНИМИ ІНГІБИТОРАМИ КОРРОЗІЇ НА СТАН ДОЇЛЬНОГО УСТАТКУВАННЯ**

*Є.М. КРИВОХИЖА*

Проведено вивчення корозійної дії експериментального зразка кислотного мийного засобу з різними інгібіторами корозії в його складі, зокрема, амонію азотнокислого, уротропіну, гідрохінону, триетаноламіну на метали, з яких виготовлені окремі деталі доїльного устаткування. Встановлено, що введення до складу експериментального зразка засобу амонію азотнокислого сприяє зниженню його корозійної дії щодо алюмінію та нержавіючої сталі.

*Ключові слова:* корозійна дія, інгібітор корозії, кислотний мийний засіб, молочний камінь

### **ПОИСК ИНГИБИТОРА КОРРОЗИИ В СОСТАВ КИСЛОТНОГО МОЮЩЕГО СРЕДСТВА ДЛЯ САНИТАРНОЙ ОБРАБОТКИ ДОИЛЬНОГО ОБОРУДОВАНИЯ**

*Є.М. Кривохижа*

Проведено изучение коррозионного воздействия экспериментального образца кислотного моющего средства с разными ингибиторами коррозии, в частности, аммония азотнокислого, уротропина, гидрохинона, триэтанолamina на металлы из которых изготовлено доильное оборудование. Установлено, что введение в состав экспериментального образца средства аммония азотнокислого способствует снижению его коррозионного воздействия на алюминий и нержавеющую сталь.

*Ключевые слова:* коррозионное воздействие, ингибитор коррозии, кислотное моющее средство, молочный камень