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RESEARCHES OF STRUCTURE OF CORROSION AND SCALE FORNATIONS IN PIPES SYSTEMS OF HEAT SUPPLY FOR SELECTION COMPOSITION OF WASHING SOLUTIONS

Abstract: The goal and the purpose of an experiment consisted in research of composition corrosion of scale incrustation formed on an internal surface of pipelines which are operated in systems of heat supply with the different heat carrier from different cities of south Kazakhstan. The composition of corrosion scale incrustation from a surface of metallic and plastic pipes in heat supply systems of Shymkent and Arys cities was established by means of a raster electronic microscope JSM-6490LV with systems of the power dispersive microanalysis INSA Energu and the structural analysis of HKL – Basic with useful magnification 300 000 in combination with the highly effective liquid Varian Pro Star chromatograph.

It is established that specific parts of corrosion scale incrustation, which taken from an internal surface of metallic and plastic pipelines in systems of supplies of Shymkent and Arys aren't identical in composition.

Knowledge of composition of corrosion scale incrustation in pipes of systems of heat supply, the date of solubilities of these elements in various solutions of acids, can promote the correct selection of washing solutions for removal of corrosion scale incrustations.

Key words: corrosion scale incrustation, washing solutions.

Introduction

According to the data of many researchers [1-3] the chemical composition of corrosion scale incrustation can be classified as: alkaline earth, silicates which complex in composition, iron, manganese and copper. Compositions of alkaline earth and complex silicates for 90% consist of carbonates, sulfates, silicates, and phosphates of alkali metals and formed as hard, dense crystal deposits in the heat pipes of networks, and in conditions of alkali boiling water falls as sludges [04.07]

At increased water content in the phosphate, iron and manganese are formed by loose-covering scum and in case the water content in copper - copper scum as a layered accumulation. During exploitation of boilers with the change of hydrodynamic and thermal regime with the boiler tube wall is washed away with highly disperse sludge, which is composed of complex carbonates and phosphates. This sludge entrained by coolant and also involved in the processes of scale formation, contributing to the formation of denser deposit layers on the inner surface of the pipe.

For removing the scaled deposits which formed on the inner surface of pipelines in heating systems should be selected compositions washing solutions so that they are removed from the inner surface of the tube exceptionally scaled deposits without damaging the metal surface [8-16].

Study methods

Objective and the task of the experiment was to study the composition of corrosion-scale deposits formed on the inner surface of pipelines exploited in heating systems with different coolant from different

cities of South Kazakhstan region. Knowledge of the composition of corrosion-scale deposits in pipes of heating systems can contribute to the correct selection of washing solution for the removal of accumulated deposits.

To achieve this goal we selected heating facilities of cities: Shymkent, Aris, with their water intake, where the average carbonate hardness of water in mgEq./l makes accordingly: 3.12; 6.26.

The composition of corrosion scale incrustation from a surface of metallic pipes in heat supply systems of Shymkent and Arys cities was established by means of a raster electronic microscope JSM-6490LV with systems of the power dispersive microanalysis INSA Energu and the structural analysis of HKL – Basic with useful magnification 300 000 in combination with the highly effective liquid Varian Pro Star chromatograph.

Discussion

Possibilities of electronic microscope allow for qualitative and quantitative analysis of scale deposits. Corrosion scale incrustation stimulate general and local corrosion of iron (pipe) which results in the destruction of the pipe, boiler, heat exchanger, radiator, and overrun is observed when operating power of about 10.8% when the thickness of deposits in the system to 2 mm [17- 20].

Useful 300,000 increase of the microscope in combination with high pressure liquid chromatography Varian Pro Star allows to identify various impurities and inclusion in the sample.

Possibilities of the microscope allow to determine the contents of all elements in analyzed samples in weight percent, as well as to see the structure of analyzed samples. In Figure 1 and 2 showed the composition components of scale incrustation taken from the inner surface of the metallic pipe of Shymkent and plastic pipe of Aris city.

It can be seen from Figures 1 and 2 elements in the composition of corrosion-scale incrustation taken from the inner surface of metal and plastic pipes in heating systems of Shymkent and Arys, not identical in composition. In scale incrustation appear plastic pipe elements such as phosphorus, sulfur, zinc, titanium, carbon, which is not observed in scale incrustation of steel pipes. Analysis of the composition of elements in scale incrustation indicates that the main component in both pipes is iron.

Элемент	Весовой,%
O	24.00
Al	0.56
Si	0.94
K	0.15
Ca	0.13
Mn	0.43
Fe	73.78

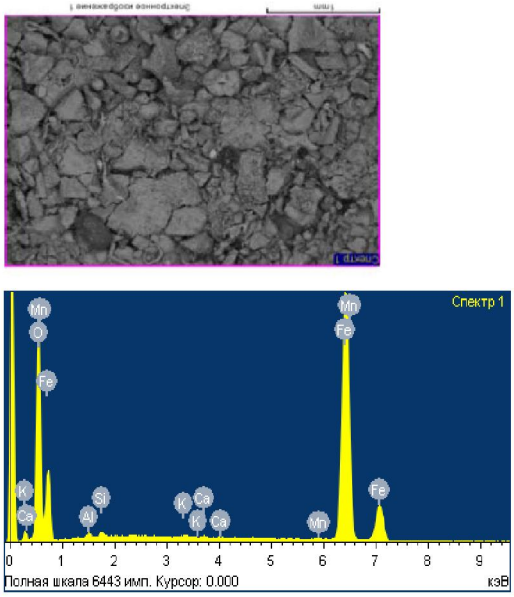

Figure 1 - The quantitative composition of the components elements in corrosion-scale incrustation taken from the surface of Shymkent metal pipe and their structure

For the study of acid action as solvent corrosion-scale incrustation on the inner surface of pipelines were selected acids - sulfamic, hydrochloric, oxalic and citric.

Obsoleted from the inner surface of the steel tubes suspended scaled incrustations an electronic microscope with a fixed structure elements placed in various acid solution with a concentration of 5% by weight, the first - sulphamic, the second - hydrochloric, the third - oxalic, citric acids in the fourth and left for five hours (minimum time of pipeline cleaning incrustation from scale in practice) at room temperature. After the specified time, composition analysis was performed on the content of these acids components.

Table 1 - shows data studies of solubility elements in the scale incrustation in solutions of various acids (Figure 1)

Элемент	Весовой,%
C	30.78
O	33.21
Na	0.33
Mg	0.54
Al	1.93
Si	4.51
P	0.20
S	0.09
K	0.60
Ca	3.15
Ti	0.24
Mn	0.22
Fe	23.81
Zn	0.40

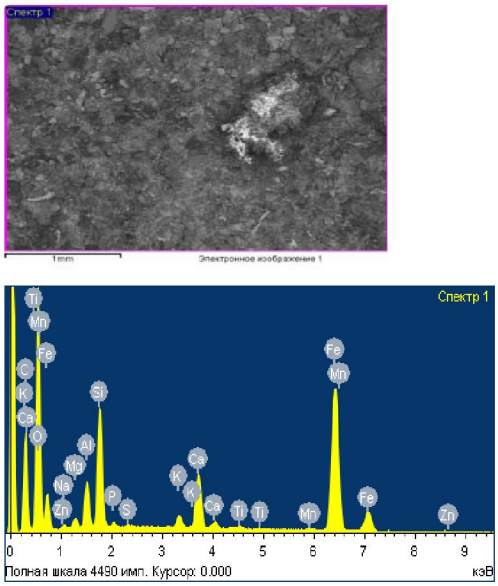

Figure 2 - The quantitative composition of the components elements in corrosion-scale incrustation taken from the surface of the plastic pipe of Aris and their structure

Table 1 - The solubility indicators of elements taken from the steel pipe in acid solutions

Acid	Elements consisting scale incrustation to their dissolution in acid	Elements consisting scale incrustation after dissolution in acid
Sulphamic acid	Al,Si,K,Ca,Mn,Fe	Iron traces
Hydrochloric acid	Al,Si,K,Ca,Mn,Fe	manganese and iron traces
Oxalic acid	Al,Si,K,Ca,Mn,Fe	silicon, iron and manganese traces
Citric acid	Al,Si,K,Ca,Mn,Fe	iron, aluminum and silicon traces

As shown in Table 1, sulphamic acid dissolves almost completely all elements except iron, whereas solution of other acids found traces of almost all the components.

Table 2 shows the solubility parameters of elements taken from the inner surface of plastic tubes (Figure 2).

Table 2 - The solubility indicators of elements taken from the plastic tubes in acid solutions

Acid	Elements consisting scale incrustation to their dissolution in acid	Elements consisting scale incrustation after dissolution in acid
Sulphamic acid	Al,Si,K,Ca,Mn,Fe,Mg,Zn,Ti,S,P,C,Ca	iron, zinc, titanium traces
Hydrochloric acid	Al,Si,K,Ca,Mn,Fe,Mg,Zn,Ti,S,P,C,Ca	manganese, iron, titanium, sulfur, magnesium traces
Oxalic acid	Al,Si,K,Ca,Mn,Fe,Mg,Zn,Ti,S,P,C,Ca	silicon, iron, manganese, titanium, zinc, magnesium traces
Citric acid	Al,Si,K,Ca,Mn,Fe,Mg,Zn,Ti,S,P,C,Ca	iron, aluminum, silicon, zinc, titanium, sulfur, magnesium traces

As shown in Table 2 sulphamic acid solution dissolves many elements except iron, zinc and titanium. In solutions of other acids the solubility of the individual elements is difficult, such as titanium, magnesium, silicon.

Conclusions: Based on the above task by selecting the chemical composition of the washing solution for the removal from the inner surface of pipelines in heating systems of corrosive scale incrustation could be successfully solved by using sulphamic acid in combination with an inhibitor.

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ЖУҒЫШ ЕРІТІНДІЛЕРДІҢ ҚҰРАМЫН ТАҢДАУ ҮШІН ЖЫЛУМЕН ҚАМТАМАСЫЗ ЕТУ ЖҮЙЕЛЕРІНДЕГІ ҚҰБЫРЛАРДЫҢ КОРРОЗИЯЛЫҚ ҚАҚ ҚАЛДЫҚТАРЫНЫҢ ҚҰРАМЫН ЗЕРТТЕУ

Аннотация: Тәжірибенің мақсаты мен міндеті: ОҚО қалаларындағы әр түрлі жылу тасымалдағыш қондырғыларда пайда болатын коррозиялық қақ қалдықтарының құрамын зерттеу. Шымкент, Арыс қалаларында жылумен қамту жүйелерінің металл және пластик құбыр қабырғаларындағы коррозиялық қақ қалдықтарының құрамы келесі аппараттар: энергодисперсті микроанализ жүйелі JSM-6_{490}LV, тиімділігі жоғары

сұйық хромотограф Varian Pro Star пен құрлымдық талдау 300000 үлкейткіші бар HKL - Basic маркалы микроскоп көмегімен анықталды.

Шымкент және Арыс қалаларының темір, пластикалық құбырларының қабырғаларынан алынған коррозиялық қақтардың құрамындағы элементтер әр түрлі екендігі анықталды.

Жылумен қамтамасыз ету жүйелеріндегі құбырлардың коррозиялық қақ қалдықтарының құрамын білу, коррозиялық қақ қалдықтарын жоюға дұрыс еріткіштер таңдауға, сол элементтердің қай еріткіштерде еритіндігін білуге мүмкіндік береді.

Тірек сөздер: коррозиялық қақ қалдықтар, жуғыш ерітінділер

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ИССЛЕДОВАНИЯ СОСТАВА КОРРОЗИОННО-НАКИПНЫХ ОТЛОЖЕНИЙ В ТРУБАХ СИСТЕМ ТЕПЛОСНАБЖЕНИЯ ДЛЯ ПОДБОРА СОСТАВА ПРОМЫВНЫХ РАСТВОРОВ

Аннотация: Цель и задача эксперимента состояла в исследовании состава коррозионно-накипных отложений, образующихся на внутренней поверхности трубопроводов, эксплуатирующихся в системах теплоснабжения с разным теплоносителем из разных городов ЮКО. Состав коррозионно-накипных отложений с поверхности металлических и пластиковых труб в системах теплоснабжения городов Шымкент, Арысь нами устанавливался с помощью растрового электронного микроскопа марки JSM-6_{490}LV с системами энергодисперсионного микроанализа INSA Energu и структурного анализа HKL – Basic с полезным увеличением 300 000 в сочетании с высокоэффективным жидкостным хроматографом Varian Pro Star.

Установлено, что элементы, в составе коррозионно-накипных отложений, взятые с внутренней поверхности металлических и пластиковых трубопроводов в системах теплоснабжения города Шымкент и г.Арысь неодинаковы по составу.

Знания состава коррозионно-накипных отложений в трубах систем теплоснабжения, данные растворимости этих элементов в различных растворах кислот, могут способствовать правильному подбору промывочных растворов для удаления коррозионно-накипных отложений.

Ключевые слова: коррозионно-накипные отложения, промывочные растворы.