УДК 579. 82

EMISSION AND ACTIVITY OF MICROBIAL CORROSION CENOSIS OF TRANSPORTED WATER "ASTRAKHAN-MANGYSHLAK" ON THE REGION OF SETTLEMENT BEYNEU (652 KM)

Kanayev A.T., Kanayeva Z.K., Myrzakhanova .I.A., Shokanova A.Sh.

Kazakh National Pedagogical University after Abay, Kazakhstan, Almaty,Dostyk av., 13

By the number and composition of microorganisms was given estimation to microbiocenosis of water in water source of river Kigach and transported water conduit "Astrakhan-Mangyshlak", shown dependence of microorganisms number from seasonal factors and anthropogenic stages. Evaluated saprophytic bacteria as environmental indicators of water quality on the basis of one-time comprehensive definition of them at different points in conduit "Astrakhan-Mangyshlak", differing from each other by fouling factor and character of polluting, as well as hydro biological regime.

Key words: microbiocenosis, water quality, *saprophytic bacteria.*

РАСПРОСТРАНЕНИЕ И КОРРОЗИОННАЯ АКТИВНОСТЬ МИКРОБНОГО ЦЕНОЗА ТРАНСПОРТИРУЕМОЙ ВОДЫ «АСТРАХАНЬ-МАНГЫШЛАК» НА УЧАСТКЕ П.БЕЙНЕУ (652 км)

Канаев А.Т., Канаева З.К., Мырзаханова И.А., Шоканова А.Ш.

Казахский национальный педагогический университет имени Абая, Казахстан, г.Алматы, пр. Достык, 13

По численности и составу микроорганизмов дана оценка микробиоценозу воды водоисточника р.Кигач и транспортируемой воды водовода «Астрахань – Мангышлак», показана зависимость численности микроорганизмов от сезонных факторов и техногенных стадий. Оценены сапрофитные бактерии как экологической показатели качества воды на основе одномоментного комплексного определения их в различных точках водовода «Астрахан-Мангышлак», отличающихся друг от друга степенью и характером загрязнения, а также гидробиологическим режимом.

Ключевые слова: микробиоценоз, качество воды, сапрофитные бактерии.

Nowadays consumers of Volga water are: oil companies, rail ways stations, gas companies, settlements of Mangystau and Atyrau regions, situated along the main conduit "Astrakhan-Mangyshlak".

Building of water line was started in 1986. In December 1987, with implementation into exploitation of a temporary water line capacity of circadian regulation, pumping station of second lifting, linear part of the initial section up to 499 km, and water treatment facilities in the village Kulsary was started commenced operation of complex conduit.

Due to demand of consumers (oil-production companies) there is a need to increase the volume of water pumped from the current 47 м^3/day thousand to 120 thousand м^3/day. Natural water from surface sources of Kigach channel in the delta of Volga is supplies to the region by conduit "Astrakhan-Mangyshlak". Volume of Volga waters supplied by conduit is 12,5% of the total consumed drinking water by the population of the region. Conduit "Astrakhan-Mangyshlak" is on the territory of Beyneu, Mangystau, and Karakiyanoe regions, has total length 1100 km. Volga water provides an average of 52,3% of the population of the above areas, including: Beyneu 87% (Beyneu village, Borankul, Zhangeldino, Syngyrlau, Eset, Tolep). Cleaning up the Volga water for appropriate quality, meeting the requirements of state standard, sanitarian rules and norms "Drinking Water", is implemented by equipment of "Degremon (France).

The problem of microbial damage is relevant, but in our country it is still not received sufficient attention. The seriousness of this problem requires the development of new physical and chemical methods for diagnosis corrosion damage. Information about role of microbiological factor in industrial materials damage accumulate, compiled and calculated losses inflicted on economic.

Purpose of this investigation – study microbial cenosis of water, transported through conduit "Astrakhan-Mangyshlak", that are water quality criteria, as well as micro-organisms involved in the process of corrosion inside the conduit on the area of village Beyneu (652 km).

Materials and Methods of investigations

Total microbial number (TMN) was defined by quantity of colony former in the nutrient medium. The resulting value is called the general microbial number. For separating bacteria and count total number microbial was used method of filtering through the membrane.

According to this method of water analysis definite quantity of water passed through special membrane with the pore size about 0.45 micrometers. As a result the surface of membrane has all bacteria found in water. After that membrane with bacteria was put for definite time to meat infusion agar with temperature 30-37^{o}C.
During this period called incubation, bacteria are able to multiply and form clearly distinguishable colonies, which are easy to count.

Determination of iron bacteria. Direct microscopy of iron bacteria, concentrated on the filter membrane, is one of the most simple and rapid methods for assessing the qualitative composition and concentration of iron bacteria in natural and drinking waters, sediments and fouling of water supplies. For this purpose, used boiled filtration membranes "Vladipor" of marks MFA-MA № 5, 6, 7 and 8 / 1.

Volume of investigate sample depended on the concentration of its iron bacteria and other suspension (1 - 1000 cm3).
After finishing filtrating, membrane was dewatered and signed. If necessary, we colored iron bacteria. Membranes in whole or in separate segments were mounted on a glass slide. For clearing membrane was used liquid petrolatum. After that was microscopy of iron bacteria.

To excretion sulfate-reducing bacteria was used nutrient medium of Postgate B, containing as carbon sources of energy and carbon, calcium lactate and yeast extract. The growth of bacteria was carried out in sealed vials, at a ratio of medium and gas phase is 1:2. As the gas phase was used argon or a mixture of molecular hydrogen - 95% and SO - 5% (19:1).

The growth of bacteria estimated by increasing quantity of protein and hydrogen sulfide samples taken at the initial point of cultivation bacteria served as control.

In order to allocate ray fungus seeding was carried out on Casein and amylaceous medium. Crops were incubated at 32 ° C in an incubator. Was carried out a differential count of colony forming units number (CFU) of actinomycetes. For this purpose used an optical microscope.

Results of investigations

The problem of quality water supply to population is particularly acute in relation with contamination of water sources, deterioration of sanitary and epidemiological situation, absence in some cases, water supply systems. The quality of water used by population for drinking and household needs is characterized by organoleptic characteristics, chemical composition and the absence of disease and the number of saprophytic microorganisms.

The quality of water supplied to the population in terms of microbiological indicators in the whole region by the share of contaminated samples was 2.5%, according to chemical indicators was 27,3%.

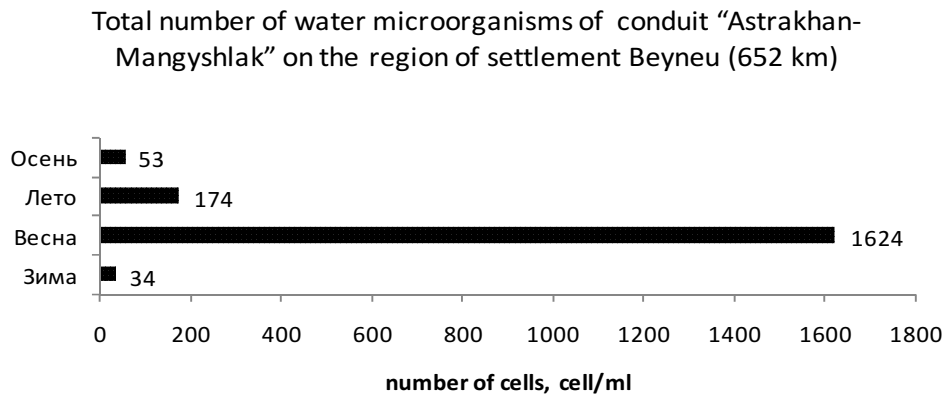
As a criterion for bacteriological contamination count the total number of colony forming bacteria in 1 ml of water. The total bacterial count normalized in 50CFU (Sanitarian rules and norms).

We investigated total number of microbial cells in 1 ml of water transported to the area of village Beyneu (652 km). As seen on the picture 1 and table 1, total microbial number in t winter period reaches to 34.0 cells / ml. Such small quantity of microorganisms is apparently due to the fact that the negative average monthly air temperature observed, mainly in December and February in northern regions in November-March, the first frosts often begins in October, the last in April. The lowest temperature observed during the second half of January, when the column of thermometer drops to 25-30 °C.

Table 1. Content microorganisms of transported water in the area of village Beyneu (652 km).

Types of microorganisms	Season of the year			
	Winter	Spring	Summer	Autumn
	Quantity of microorganisms, cells / ml			
Total number of microorganisms	34	1624	174	53
Iron oxidizing bacteria	102	104	103	102
Sulfate-reducing bacterium	105	106	105	102
Microscopic fungi	0	83,5	610	118
Actinomycetes	0	295	400	53

Average temperature in January ranges from 2,0-2,80 °C in the west and south-west to 8,1-12,80 °C in the north and north-east (Duken, Sam), area is characterized by winter thaw, ice and snowstorms.
Spring in this regions comes fast, continues one month (March – on the south and April on the north). Due to this fact the high microbial number is observed during the spring season. The total bacterial number at this time is up to 1624 cells / ml, indicating that the overall bacteriological contamination of water supplies and about the probability of presence pathogenic microorganisms (Pic.1)



Picture 1

Climate of Beyneu village is sharply continental, characterized by hot and dry summer. Maximum average monthly temperature of air is in July (23,3-28,30° C), in this month in some days is fixed the hottest (43-470 °C). In this context, probably in the summer season the number of total microbial number sharply decreased to the level of 174 cells / ml. Autumn is characterized by short transitional seasons. Also by low air humidity and a slight, but highly variable number of outliers in different periods of precipitation, as well as greater stability of wind and high solar radiation.

Average annual air temperature on the territory of the region changes from 9,7 till 12,50 °C. In this period of year quantity of total microbial number in water of conduit “Astrakhan-Mangyshlak” on the region of settlement Beyneu is 53,0 cells /ml (pic.1).

Also, we studied the bacteria involved in corrosion processes and the processes occurring under the influence of microorganisms life activity, which differ in wide spread occurrence and diversity of conditions and environments in which they occur. Pathogens are aerobic corrosion thione and iron bacteria.

Among lithotrophic bacteria most commonly associated with metal corrosion activity: sulfate-reducing bacteria (SRB) sort of Desulfovibrio and Desulfotomasulum and thiobacteria sort of Tiobacillus, oxidizing sulfur and sulfur compounds to sulfuric acid, iron bacteria of Sallionella and Sperotilus, oxidizing soar iron to ferric. As seen from table 1, quantity of iron oxidizing bacteria in winter period of the year is 102 cells /ml. This

This figure in the spring increases twice larger and their number reaches to 104 cells / ml. In Summer is observed slump of their number to 103 cells / ml, in Autumn number of iron oxidizing bacteria reaches the minimum number - 102 cells / ml (pic. 2).

As a result of life activity of thiobacteria aggressive corrosive environment created by the accumulation of sulfuric acid - the end products of their metabolism. Thus, the type of aggressive environment, which runs the corrosion process can be biocorrision. In this case oxidation of iron (II), catalyzed iron oxidizing bacteria proceeds by the formula: $4Fe2{+}{+}O2+6H2O=4FeO(OH)+8H+$.

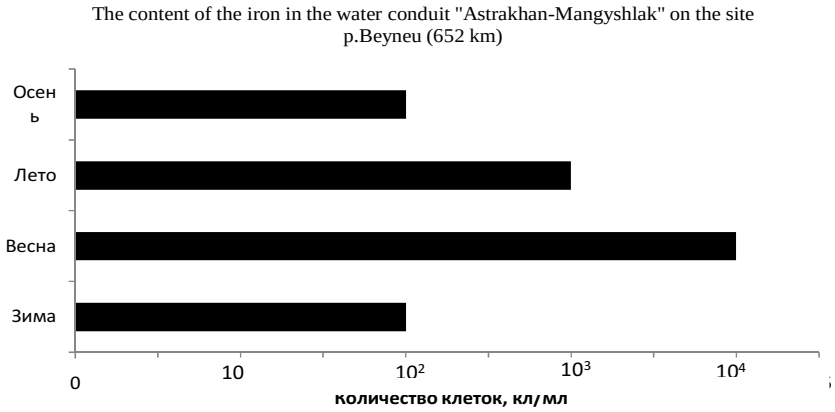
The resulting goethite FeO (OH) covers the walls of water line as a characteristic yellow-orange plaque.

As we know, the restoration of microorganisms completely or partially oxidized sulfur compounds of the mineral sulfur in anaerobic conditions due to the oxidation of organic substance or hydrogen called microbial sulfate reduction.

Sulfate-reducing bacteria can cause corrosion of metal culvert structures of conduit. As a result of life activity of sulfate-reducing bacteria is formed hydrogen sulfide - a toxic substance and a strong reductant, the oxidation of which in water and silt deposits oxygen is absorbed, and in stagnation conditions are produced anaerobic zone. This leads to depression of benthic fauna.

Purpose of the next investigation is to determine number of sulfate-reducing microorganisms in the water conduit “Astrakhan-Mangyshlak” on the region of settlement Beyneu (652 km), participated in the corrosion of conduit.

It should be noted that the sulfate-reducing bacteria in sufficient quantities found in all taken water samples. Their number in winter is up to 105 cells/ml. This figure in spring rises to one rate higher - 106 cells/ml. But in summer there is gradual reduction of their number to 105 cells / ml and in autumn decreases to 102 cells / ml (pic.2).



Picture 2

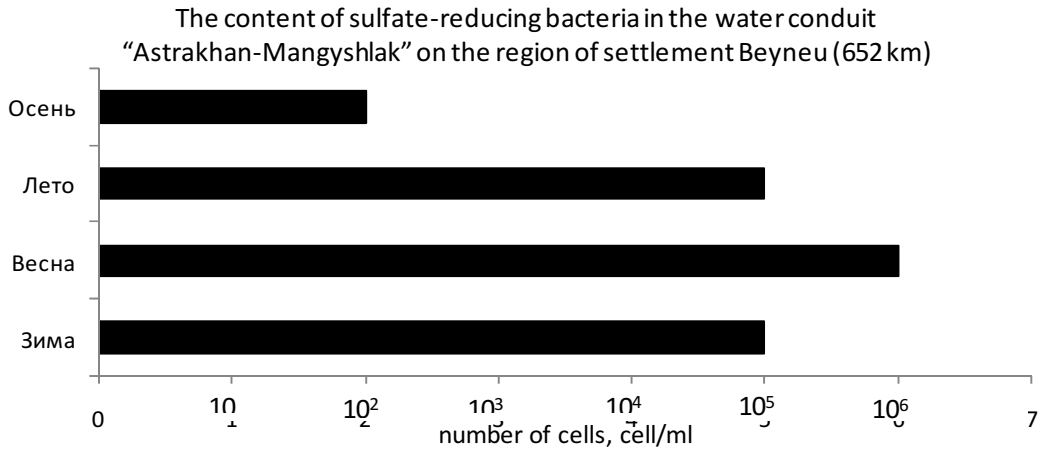
Thus, the main causative agents of anaerobic corrosion of sulfate-reducing bacteria are sulfate-reducing bacteria responsible for the reduction of sulfates to hydrogen sulfide and related to the sort of Desulfotomaculum.

A number of aquatic microscopic fungi are an essential component of fouling surface and submarine building, causing biodegradation of different materials.

Due to this fact we considered it necessary to examine a number of aquatic microscopic fungi living in the water conduit “Astrakhan-Mangyshlak” on the region of settlement Beyneu (652 km). As far as we know, among the fungi that live in aquatic ecosystems, there are two large categories: permanent inhabitants of the aquatic environment and immigrants appearing in ponds periodically, with confined to specific seasons or without it.

Fungi of the first group (zoospore, aquatic hyphomycetes) the whole life cycle is carried out in the water and plays a significant role in the trophic network of water reservoirs. Fungi of the second group - Terrigenous - not homogeneous in their adaptation to survival in the aquatic environment, some of them are inactive forms, disappears with time, and active.

As seen from pic.4 and table 1, microscopic fungi in winter period are missing. However, in the spring their number reaches to the maximum (83.5 cells / ml). Then, in summer and autumn period, the number of microscopic fungi is reduced to 3,5 and 4.5 cells/ml, respectively.



Picture 3

Thus, the action of microorganisms on metals can be different. First of all, the corrosion of metals can cause aggressive exometabolites of microorganisms - mineral and organic acids and foundations, ferment, etc. They create a corrosive environment in which in the presence of water, corrosion occurs by the usual laws of electrochemistry. Colonies of microorganisms can create nodes and pellicle of the mycelium or mucus on the metal surface, to which may develop peptic ulcer (pitting) corrosion due to the difference in electrical potential in different

parts of the metal surface and the assimilation of metal ions by the microorganisms. Biological corrosion of metals can cause different kinds of microscopic fungi.

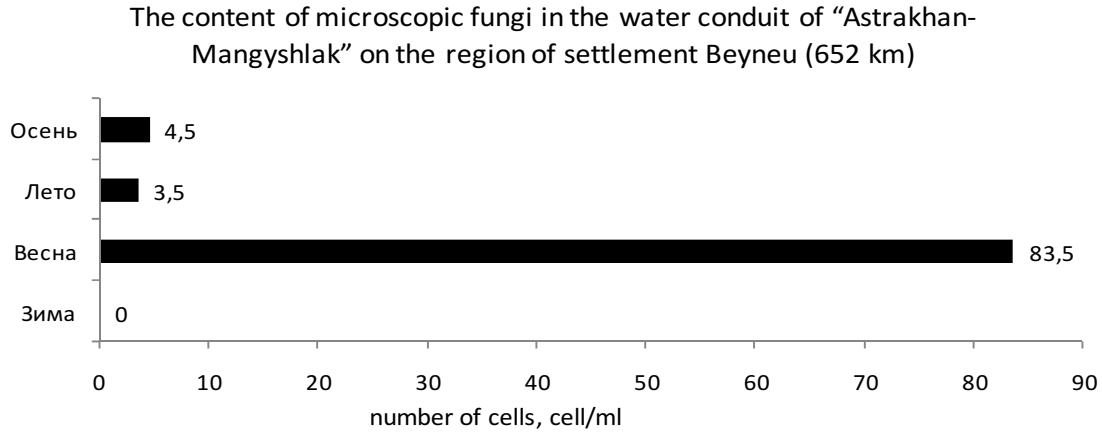
In the water conduit “Astrakhan-Mangyshlak” with the participation of microorganisms there are constant processes of destruction organic substance of autochthonic and allochthonic origin. In the result of continuously supported processes of bioproducts, there is an intense self-cleaning of water in conduit.

Participation of each physiological group of microorganisms and each bacteria is inseparable from each other and and proceeds in the complex.

For better understanding the structure and functioning of the microbial community in conduit, it is necessary to investigate the role of its individual members. In this connection it is undoubted interest to investigate the biology and ecology of actinomycetes inhabiting the waters of conduit “Astrakhan-Mangyshlak”.

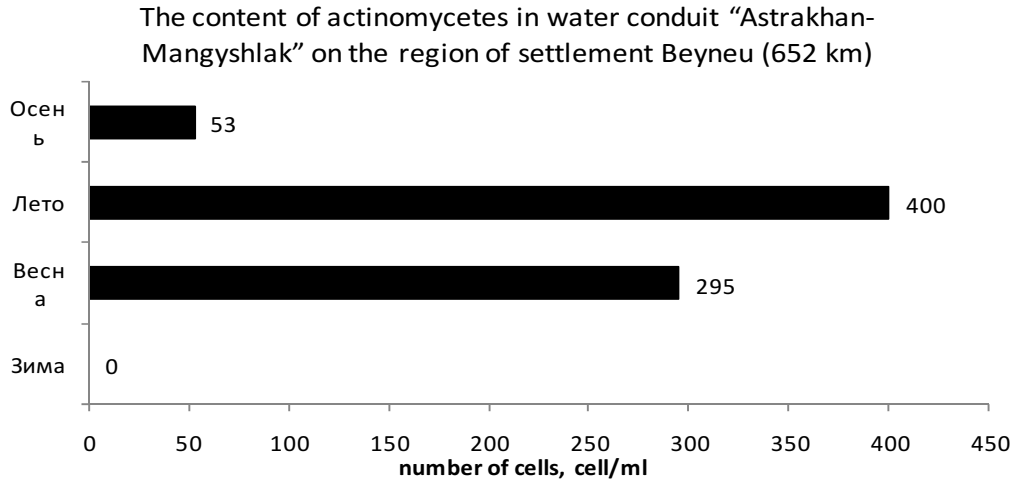
The purpose of this investigation was separation and definition number of actinomycetes from water in conduit “Astrakhan-Mangyshlak”.

The received data during investigation of actinomycetes in the water conduit are shown in the picture 4 and table 1. The results of investigations show that actinomycetes were missing in winter.



Picture 4

With the coming of spring, the number of actinomycetes increases dramatically and reached to 295.0 cells / ml, while in summer their number increased to 400.0 cells / ml. In the autumn period, the number of actinomycetes in water decreased to 53.0 cells / ml (Table 1, Picture 5).



Picture 5

Thus, we observe that for the growth and development of actinomycetes temperature factor is very important.

With coming of spring and summer population of actinomycetes adequately increased.

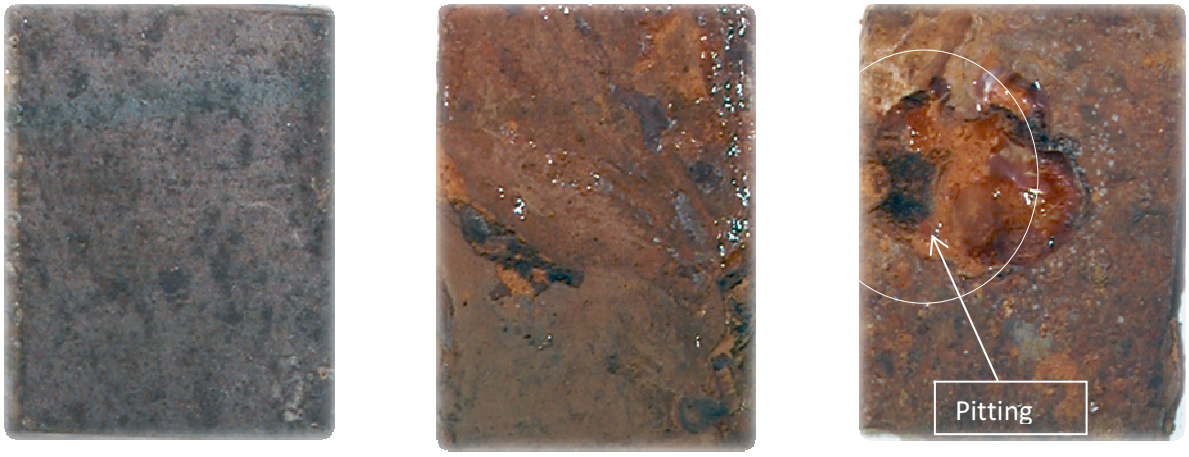
Word corrosion is come from Latin *corrodere*, that means – corrode. Corrosion caused by oxidation-reduction reactions in which metal is a result of interaction with any substance from its environment becomes an unwanted connection. One of the most famous of corrosion processes is the rusting of iron.

Object for the next investigation was metallic plates of mark ST, which were subjected to corrosion in an environment with an association of sulfate-reducing and iron oxidizing bacteria.

We should form a representation of biological corrosion in terms of redox processes; show the importance of biocorrosion for the national economy, and to establish a causal connection between the structure and properties of metals.

For this purpose, iron steel plate ST-4 was put into water environment supplemented with cultures of sulfate-reducing bacteria and iron bacteria.

The experiment was performed in three variants: A - plate was not subject to processing (control), B - plate was subject to processing in the environment without bacteria; C - plate was subject to processing in the environment with microorganisms. In the picture 6 are shown the final results after eight-week processing of steel plates.



A B C

Picture 6.

As we can see from picture 6, the corrosion of metals caused by sulfate-reducing and iron bacteria that inhabit the water conduit "Astrakhan-Mangyshlak" on the region of settlement Beyneu (652 km) is continuous and local. At pic.5 B we can observe continuous corrosion, which is not particular threat to structures, especially in cases where the loss of metals do not exceed the technically based norms. Its effects can be relatively easily considered.

On the pic.6 C is clearly seen spot (point) corrosion, which represents a significant threat, although the metal loss here can be small. Pitting is one of the most dangerous types of local corrosion. It is the formation of cross-cutting lesions that is in the formation of cavities point - the so-called pittings. As it shown on the pic.6 C, local corrosion is favorable for the sulfate-reducing and iron bacteria. The danger of local corrosion is consisting in that reducing the strength of individual parts; it dramatically reduces the reliability of the water conduit.

So, microbiological corrosion can be different: due to the direct effects of metabolic products of microorganisms (CO_2, H_2S, NH_3, organic and inorganic acids) on steel (ST-4); through the formation of organic products, acting as a depolarizer or catalysts of corrosion reactions, as well as same subject, when corrosion reactions are a separate part of the metabolic cycle of bacteria.

List of literature:

1. Namsarayev B.B., Barkhutova D.D., Khakhinov V.V. Field practicum on water microbiology and hydrochemistry // Ulan-Ude . Publication of Buryat State. 2006.

2. Henuion B., Blink R., Brihner L.H. The use of zink phosphate inhibitors for an anti-corrosion water treatment // Corrosion, 1996, V. 52, № 9, P. 584-591.

3. Van. Der Merwe S.W. The effect of water quality veriables on the corrosion behavior of water coaqulated with a cationic polyelectrolyte and with lime / activated silica // Water supply , 1988, Vol. 6, P. 966.

4. R.F.Majtova, L.I.Kantor. Modern methods of a sanitary-microbiological estimation of quality of water//Water supply and the sanitary technics, 2004, №4, P. 20-21.

5. Grabow W.O., Coubrough P. Inactivation of hepatitis A virus, other enteric viruses and indicator organisms

in water by chlorination // Water Sci. and Technol., 1985, №17, P. 4-5.

6. N.F.Gray. Drinking water Quality. Problens and Solution, Bonn, 1994, P. 112.

7. Sergevnin V. I, Sharipov I.S.qualit of potable water, water removals and population health//Materials inter-regional scientifically-practical conference, Ryazan, 2000, P.70-71.