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# Reagent Method For Wastewater Treatment In Textile Industries

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## i. INTRODUCTION.

Textile enterprises are large consumers of water for technological needs. The wastewater of this industry is very complex in its composition of various types of dyes, surfactants, mineral salts and suspended solids, etc. There are various advanced technologies for treating industrial wastewater that prevent environmental pollution. The textile industry produces wastewater containing in its composition a combination of sparingly soluble organo-and mineral complexes. They contain natural and synthetic fibers, paints, etc., which are characterized by high color and alkalinity. The chemical composition of dyes includes toxic elements (Cu, Zn, Pb, Cr, Ni, solid metal ions).

Currently, a huge amount of difficultly contaminated wastewater is discharged from textile enterprises, which are considered the most dangerous harmful substances and, almost without treatment, directly enter natural water bodies. At the same time, they threaten both an aquatic living creature and residents living closer to the lake and river. The most acute environmental problem in the textile industry is the release into the environment of liquid waste from finishing production, since they accumulate the most harmful unused substances and synthetic dyes in their composition. A very small amount of dyes in wastewater can be toxic. Therefore, by a cleaning method, the removal of dyes from streams, ensuring the transparency of textile waste water, becomes an environmentally important task. According to the International Cancer Agency (ICA), carcinogenicity of dyes is proven for animals for only a small number of substances, almost exclusively azo dyes, which in total comprise almost 70%. Allergenic action is proven for a number of dyes, mainly active and dispersed. The maximum permissible concentration of active dyes in water is
10 mg/m$^3$ [1]. In this regard, studies are underway in the world to improve existing, as well as the development of new effective methods for the treatment of wastewater in the textile industry.

Laskov Yu.M. and his co-workers [2] analyzed various methods (flotation, adsorption, electrodialysis, ultrafiltration, etc.) of wastewater treatment at silk and knitwear enterprises.

The authors of [3-10] developed and studied physicochemical methods for pretreatment of wastewater from textile enterprises, including coagulated, electrocoagulation, flotation with and without reagents, oxidation with ozone, chlorine, hydrogen peroxide, electrochemical oxidation, reduction sodium hydrogen sulfate, acid solution of rongalite, iron shavings of the joint acidified with sulfuric acid, its subsequent neutralization and sedimentation

In the most technologically advanced countries, the textile industry ranks sixth among other industries, both in terms of water consumption and the volume of industrial wastewater discharged [11]. The main technological operations of textile production include such water-intensive processes as dyeing and wet finishing of fabrics. The discharge into the sewer of waste from dyeing and finishing industries reaches very significant values, for example, surfactants up to 90% [12]. However, despite the fact that it uses ~ 300 different chemical reagents to process and dye fabrics and fibers in textile enterprises, only 30-50 of them are contained in wastewater with a concentration of more than 5 mg/dm$^3$ and only 6-15 types of chemical reagents are in the form of truly or colloidal dissolved substances, i.e.

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the most difficult to remove [13-15]. Substances polluting wastewater mainly have two sources of origin - either those contaminants passing into wastewater in technological processes from fabrics and fibers, or contaminants entering wastewater from technological solutions used in the preparation, finishing and dyeing of textile materials. If there is some information on the second type of pollution in the specialized literature, although it needs to be supplemented and analyzed, then on the first type there is practically no information, due primarily to the difficulty in identifying these impurities. Meanwhile, the contribution of this type of compounds to the total value of wastewater pollution is very significant. So, according to [14], 25-30%, pollutants in wastewater are the products of desizing and destruction of the processed fiber. According to other studies, sizing preparations account for 50% of waste water, fiber destruction products 25%, finishing products 13.8%, chemicals and dyes 11% [13]. Wastewater, along with dyes, contains other related organic and mineral impurities: various surfactants, mineral acids, chlorides, su lfates, heavy metal ions, etc. Depending on their ratio, color, turbidity, pH, and ionic changes over a wide range. compo sition of water.

Therefore, universal methods for treating colored wastewater have not yet been develo ped. At the same time, there are many developments on the bleaching of colored industrial wastewater to a sufficientl y high degree of purification, many of which have not gone beyond laboratory research.

**Objects and research methods.** As objects of research were used: ashes of «Angren TPP», aluminum sulfate, calcium oxide and waste from sugar production-defecate, as well as sewage from textile production.

A study was conducted on the treatment of treated wastewater of the Khorezm textile mill, according to the main indicators of pH, color, salt composition, etc.

For the first time, the following was used for cleaning: defecate - a waste product from the «Khorazm Shakar» sugar production, which is characterized by the following average chemical composition ( %), which is shown in Fig. 1.

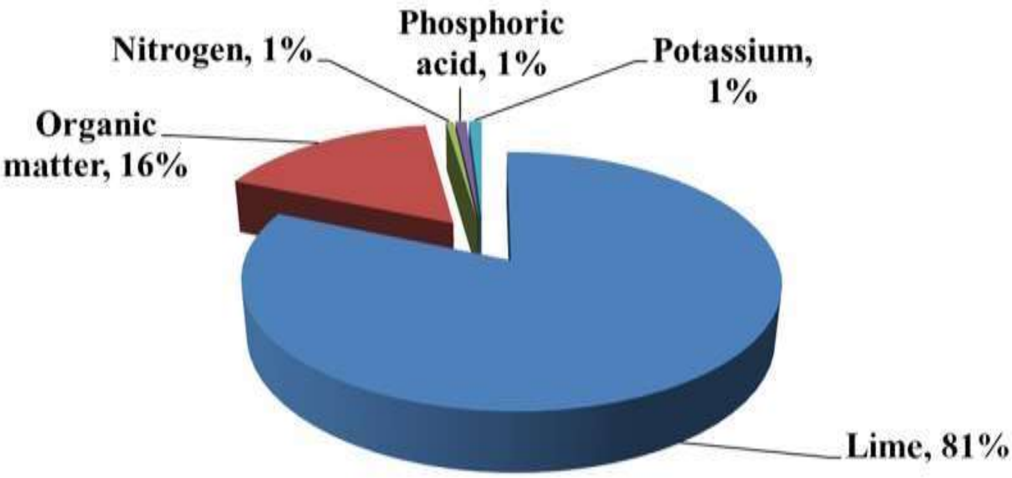


**Fig. 1. The chemical composition of the defecate ( a waste of sugar production “Khorezm Shakar”)**

Defecate differs in its composition, depending on the variety of raw materials and production, mainly in dry raw materials (at a moisture content of 25-30%) contains [18]: - Lime - 60-70%; -Organic substances - 10-15%; -Nitrogen - 0.2-0.7%; - Phosphoric acid - 0.2-0.9%; -Potassium 0.5-1% -Significant amount of sulfur, magnesium and trace elements. The main defecate is lime - 60-70%.

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The defecate was fired with oxygen at 650° C. In this case, during the thermal process, the calcium carbonate form is converted from calcium defect to calcium oxide. Radiographic and electron microscopic studies (SEM) were carried out, as well as IR spectra of the calcined defecate at 650° C with oxygen access in the muffle cabinet (Fig. 2).

Currently, coal-fired power plants produce about 40% of the total electricity in the United States, Germany and other other countries, about 70%, in China, India, Australia, more than 70%. When coal is burned at TPP, large-tonnage ash and slag waste is generated, where the specific surface of the powder (by product) is cm2 / g ~ 1000.

The highly dispersed fly ash of the Angren TPP from cyclones is characterized by the following chemical composition (%):

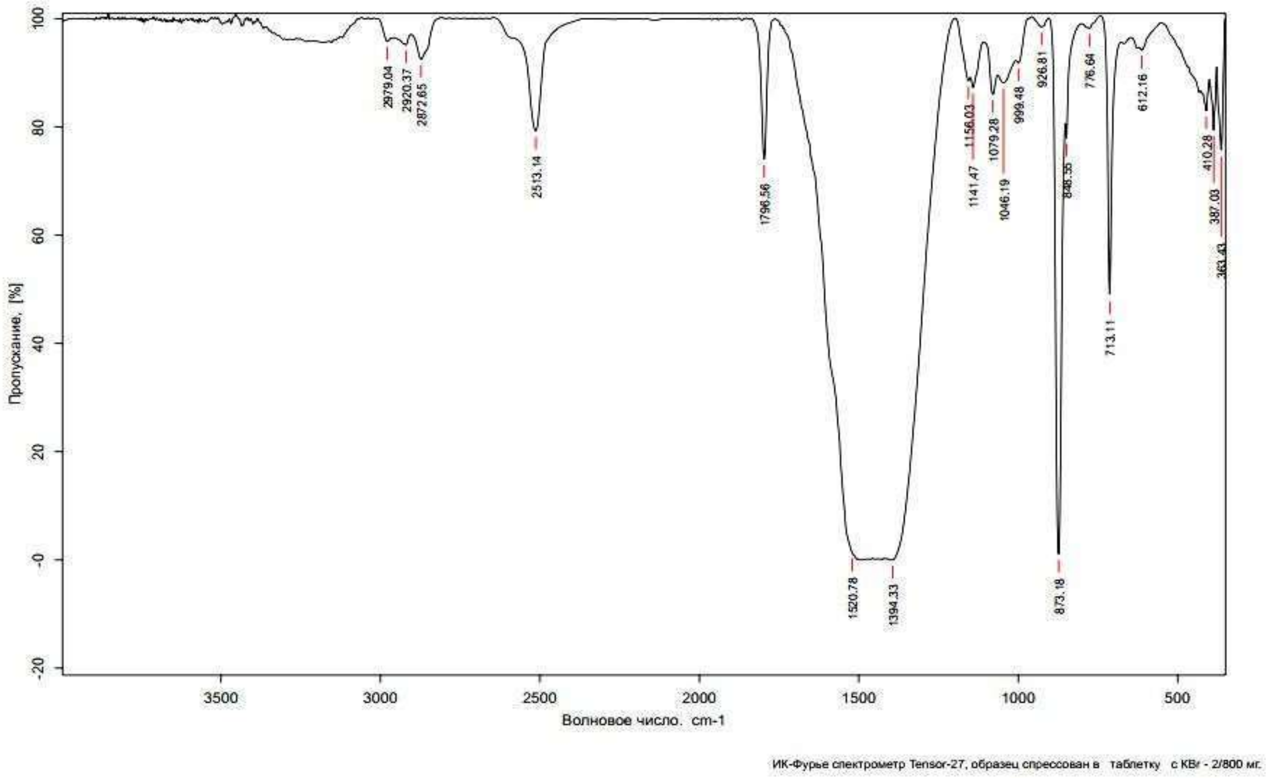


**Fig. 2. IR spectra of the calcined defecate at 650 ° C.**

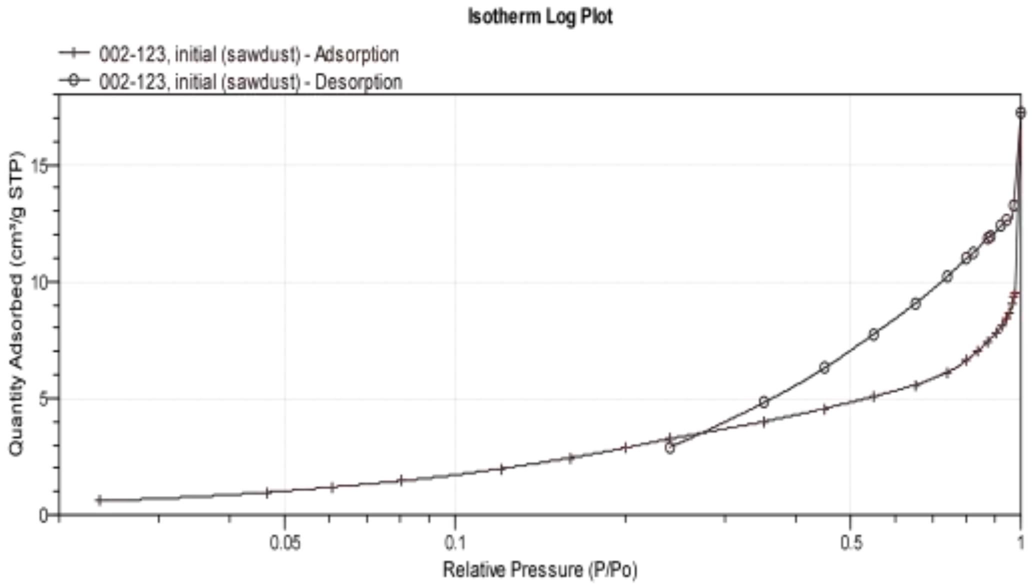


**Fig. 3: Isotherm of low-temperature nitrogen adsorption on annealed defecate at 650 ° C**

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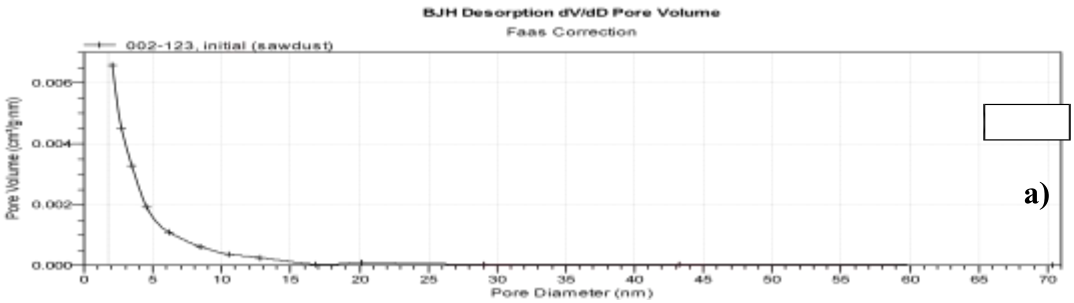
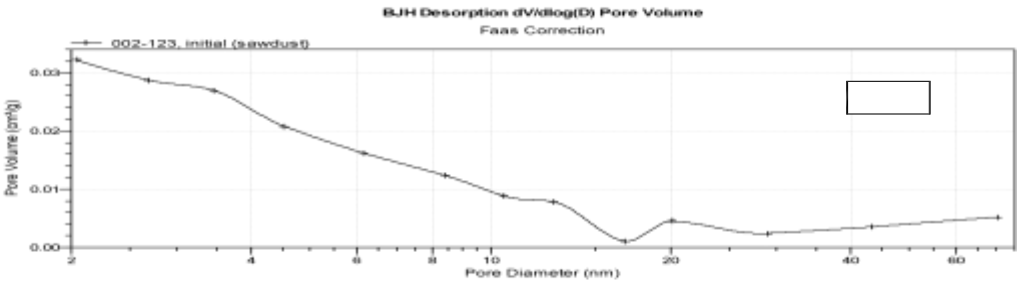



а)




б)

**Fig. 4.a. and b. Distribution curves of the pore volume of the calcined defecate at 650 °C along their rad. (r, nm)**

To characterize the porous structure of the samples on the basis of isotherms of low-temperature nitrogen adsorption (Fig. 3), taken on a Quantacrom instrument (in Belarus), the BET specific surface area and pore volumes were calculated (Fig. 4, a and b). The analysis of nitrogen adsorption isotherms on the calcined defecate at 650° C showed that they have pores of various sizes. The pore size of the calcined defecate at 650° C was calculated according to BET, which was 15.8774 m² / g. Since a very small surface according to Langmuir is 32.8917 m² / g. Ash is a lot of tonnage, cheap and easily accessible waste. When treating colored wastewater, the ash and defecate ash, calcium and aluminum oxide chloride compositions (at a ratio of 1: 1: 0.5: 0.05) were introduced at concentrations of 1000-15000 mg / l. Secondary waste after adsorption purification of water from dyes can be used in the construction materials industry.

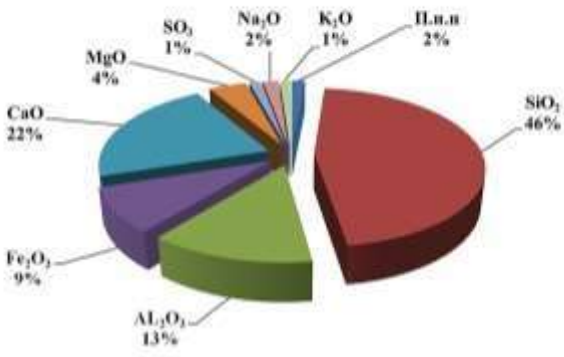



**Fig. 5. The chemical composition of fly ash of Angren TPP, %**

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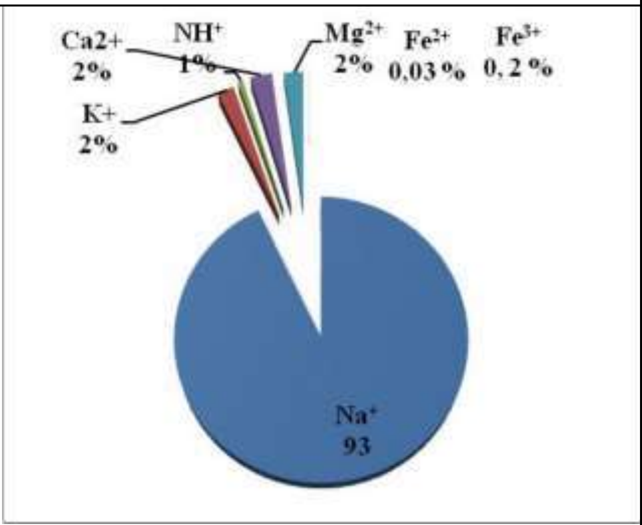
Calcium hydro silicate - $CaSiO_3$. A distinctive feature of the proposed adsorbent reagent is its high dispersion, which is ensured by the method of its preparation at the moment of pouring two solutions - calcium chloride and sodium silicate in concentrations corresponding to the production of calcium hydro silicate sol and its transition into a gel.

The essence of the water treatment method is the formation of a sorption system of calcium silicate at the stages of the sol-gel transition with further coagulation with aluminum sulfate. Calcium hydro silicate was prepared by pouring 0.2% solutions of calcium silicate and calcium chloride, based on the calculation of the given quantities of the active product - calcium hydro silicate. At the moment of the draining of these solutions, a white finely divided precipitate immediately precipitates, and the entire suspension is poured into colored water, then mixed. It should be noted that one of the components of the preparation of calcium hydrosilicate – c alcium chloride — was obtained from the Kungrad soda plant, where a 15% solution of this compound is a lot of tonnage production waste. Its cost is 5-6 thousand soums per ton.

Aluminum sulfate $Al_2$ $(SO_4)$ 3 18 $H_2O$ was used as a coagulant, which was added both independently and in combination with adsorbents. The degree of discoloration was determined using the optical method based on measuring the amount of absorbed and scattered light by the studied medium on a photometric calorimeter (FEC) - LF-72 M. For each water, the necessary filter and a cuvette with a thickness of 10 mm were selected. Distilled water was used as a comparative solution. The study was conducted by the drains of the Khorezm textile enterprise as studying their chemical composition, which is shown in Fig. 6 and Fig. 7.

| The cation content in liter, % | Other definitions |
|---|---|
| | Hardness mEq / L |
|  | Total -3,20<br>Disposable<br>Constant<br>Carbonate no<br>Non-carbonate -3,20<br>pH -11,20<br>$CO_2$ freedom mg / alkaline<br>$CO_2$ freedom mg / l sample |
| **Anion content in liter, mg / l** | Oxidation mg O2 alkaline |

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| | |
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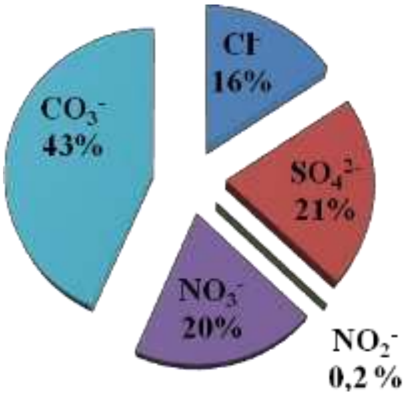
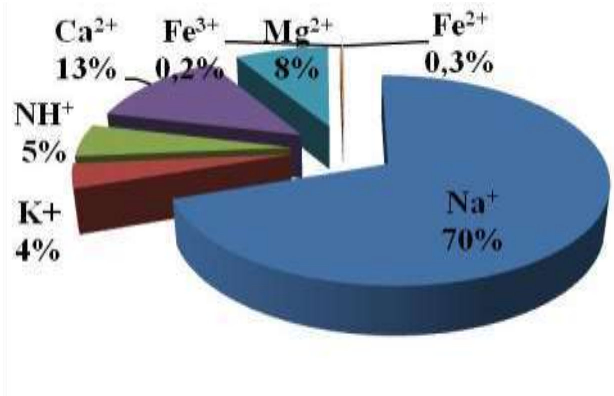
|   | |
| Water salt formula $95\frac{CO_3^{54}\cdot Cl^{16}\cdot SO_4^{16}}{Na^{91}}$ | COD = 833,40 mg $O_2$/l BOD $_5$ = 208,30 mg $O_2$/l Sorgan. = 312,52 mg S/l Sediment = 25 mg/l = 0,025 g/l |

| **Cation content in liter, %** | **Hardness, mg-eq / l** |
|---|---|
|   | Total -3,80<br>Disposable<br>Constant<br>Carbonate-3.80<br>Non-carbonate-no<br>pH -6,20<br>$CO_2$ freedom mg / l-22<br>$CO_2$ freedom mg / l-12 |
| **Anion content in liter, %** | Oxidation mg $O_2$/l |

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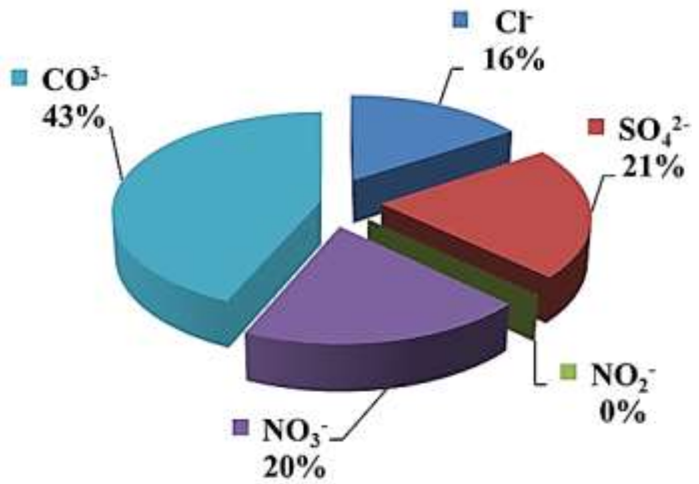
| | |
|---|---|
|   | $SiO_2$ mg undetectable sample<br>$H_2S$ mg / l-no<br>$PO_{4mg/l}$<br>Dry residue: Experim-840<br>mg / L Calculated-816 mg / L Physical<br>sv-va does not mean Transparency is<br>transparent Taste is fresh<br>Colorless grayish yellow Smell-<br>insignificant. Sludge-free sediment<br>Rev. when standing, no modified<br>$Na^+$ on a flame photometer -200 mg/l |
| **Water salt formula**<br>$0{,}84\frac{SO_4^{36}\cdot Cl^{33}\cdot HCO_3^{30}}{Na^{64}\cdot Mg^{15}\cdot Ca^{13}}$ | COD = 41,67 mg $O_2$/l<br>$BOD_5$ = 18,30 mg $O_2$/l<br>C organ. = 15,63 mg S/l<br>Sediment = is absent |

**Fig. 7. Chemical properties of wastewater of the Khorezm textile enterprise**

The sludge after treatment is a gel-like precipitate in which the proposed sorption system is ~ 30% by weight of the weight of the treated wastewater products, compact after drying.

Comparative data on the cleaning of dyes from real sewage textile production - Khorezm textile production using a reagent: ash - waste TPP, defecate - waste sugar production, aluminum sulfate and calcium hydroxide. The study was carried out as follows: for 100 ml of stained wastewater containing dyes, 1% ash was introduced; the waste from the heat and power plant was stirred for about 5 minutes, then the calcined defecate was added thereto at 650° C in an amount of 1%, then it was added to the mixer without heating at 300 rpm About 5 minutes. By adding aluminum sulfate, 0.05% is stirred for a duration of 10 minutes. Flocculation and coagulated suspensions occur. At this point, coagulation begins, in the impurity precipitation begins. To reduce the time of clarification of wastewater, we add 0.5% calcium hydroxide. The maximum clarification of the solution occurs almost instantly, so that after 2-5 minutes the suspension can be separated. After that, the test sample is subjected to sedimentation. We take it without adding calcium hydroxide to the wastewater, we can observe clarification in the effluents, but after moving the duration of the deposition of impurities increases 3 times, and the wastewater clarification has a turbid state. The advantage of this method over other solid adsorbents is the ability to separate the suspension by a separate method, because the gel has stabilization in a conventional separator. The process of reuse of sludge is carried out 8-10 times, and thereby reduces the cost of wastewater treatment.

From the data table. Figure 1 shows that the efficiency of reducing the color of dyed wastewater studied in textile enterprises is much higher than the previous ones studied by solid adsorbents. Thus, in the treatment of colored

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| | **The dose of ash, mg/l** | **Defecate dose mg / l** | **Dose of aluminum sulfate, mg / l** | **Dose HSC, mg / l** | **Reduction efficiency staining intensities, %** |
|---|---|---|---|---|---|
| The water is black, very muddy, very colored, pH = 11,0 | | | | | |
| . | 1 | 1 | 0,05 | 0,5 | 97-98 |
| . | 0,5 | 1 | 0,15 | 1 | 80-82 |
| . | 0,8 | 1 | 1 | 0,5 | 96-97 |
| . | 0,5 | 1,5 | 0,5 | 0,5 | 78-80 |
| . | 1 | 1 | 0,15 | 1 | 90-91 |
| . | 1 | 1 | 0,2 | 0,5 | 72-75 |

To assess the degree of dyeing of textile wastewater by the ratio of “ash: defecate: aluminum sulfate” and calcium oxide, respectively 0.8:1:1:0.5, it was observed that the degree of treatment reaches 96-97%. But, the addition of 1% aluminum sulfate in an amount much larger, this suggests that, due to the economy, the sewage treatment cycle does not justify itself, because used reagent aluminum sulfate is more expensive. Our goal is that with the use of local waste, the regional problem of environmental protection is solved.

It should be noted that in the technological process at the bleaching and dyeing factories of the Khorezm textile production sodium silicate or metasilicate is used, in this connection, in some cases, the wastewater has a pH of 9-10 and in this case it is enough to add only calcium chloride to them, after which the formation of calcium hydrosilicate and the discoloration of stagnant water begins.

On the other hand, if the wastewater has a high hardness, a high content $Ca^{2+}$, only add $Na_2SiO_3$ and aluminum sulfate.

The possibility of using calcium hydrosilicate waste with adsorbed dyes, surfactants can be considered as its additive in concrete mixtures in the production of building materials, and in terms of regeneration (roasting at 400-500° C) and reuse for wastewater treatment.

It should be noted that the calcined defecate at 650° C and its composition with Angren ash at a ratio of 1:1, as well as the reagent calcium hydrosilicate with aluminum sulfate, can serve as effective adsorbents in the treatment of dyed textile wastewater.

Thus, it can be said that adsorbents - calcined defecate at 650° C, highly dispersed ash of Angren GRES can be used as effective adsorbents in the processes of adsorption treatment of dyed wastewater in the textile industry.

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Moreover, it should be noted the cumbersome cycle of this cleaning method, due to the assembly of additional containers, the need for large quantities of adsorbents, as well as the accumulation of a significant amount of waste.

We have taken electronic photos of the surface of the wastewater of a textile enterprise before and after their cleaning using a binocular digital microscope model NLCD-307B.

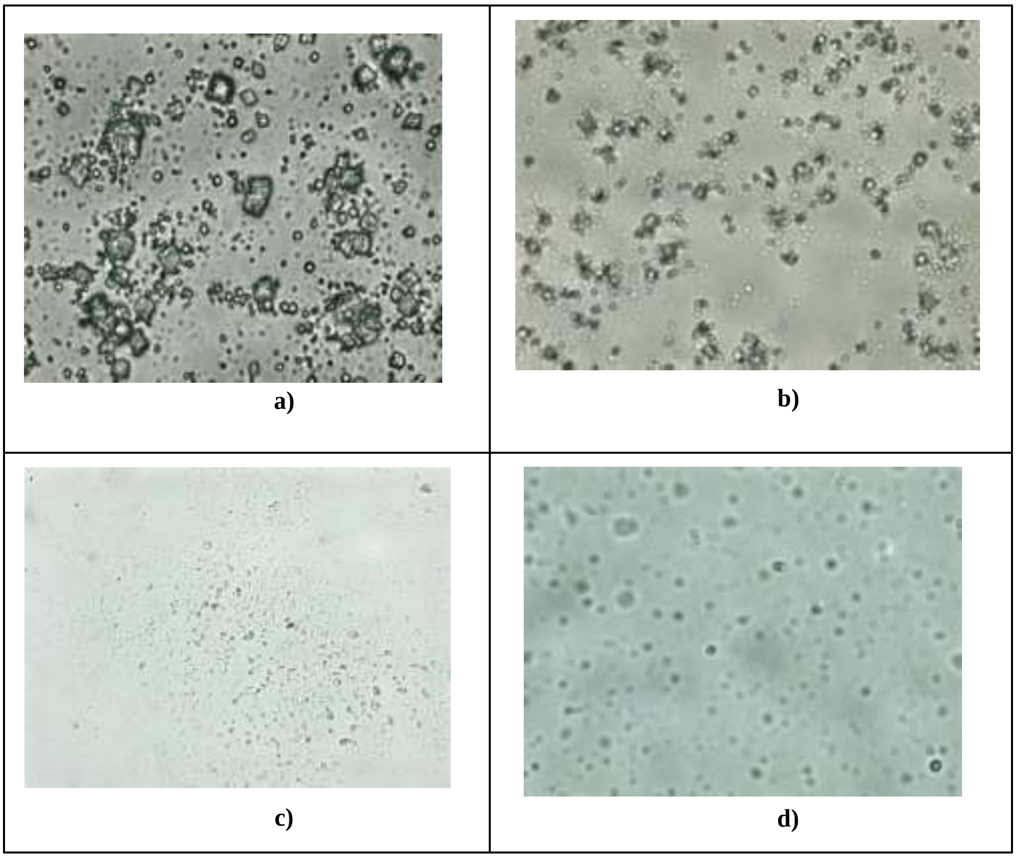


**Fig. 8. Micrographs of the wastewater surface of the Khorezm textile production. Pictures a: b: c: d taken at a magnification of 1000: 400: 400: 100, respectively**

When photographing in a digital microscope solution, the studied area of the object was determined, the image was focused and the desired magnification was established. The analysis of photographs (Fig. 8, a to d) and the surface of the appearance of the solutions show that the area a) the initial runoff is 100% of impurities, b) more than 70% of impurities, surface c) and d) about 25% of impurities, i.e. to. it is a coagulation method after purification.

Thus, it can be concluded that the adsorbents are calcined defecate at 650 ° C, highly dispersed ash of the Angren TPP and can be used as effective adsorbents in the treatment of dyed wastewater in textile production, however, the cycle time of this cleaning method due to the assembly of additional containers (for loading adsorbents), the need for large quantities of adsorbents, as well as the accumulation of a significant amount of waste.

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