Information for Technical Managers
Adsorbent for Physico – chemical purification of Water
(Drinkable, industrial sewage, reclaimed)

We offer you «Sorbent AS» aluminosilicate adsorbent produced on the basis of ecologi-cally pure mineral raw material in Sverdlovsk region to introduce in water treatment.

Technical Data

Bulk density, kg/m^3:	450-490
Specific surface, m^2/g:	100 - 120
Abrasion, %:	0,06
Grindability, %:	0,14
Tentative mechanical strength, %:	0,79
Coefficient of grain form:	1,65 - 1,71
Intergranular porosity, %:	42 - 56
Capacity on oil products in dynamic conditions, mg/g:	170
Coefficient of radioactive nucleus distribution:	10^3 - 10^4

We produce standard fractions and at a request of a customer.

Fields of Application and Solutions.

«Sorbent AS» is used in centralized systems of water treatment, in reclaimed service systems of water treatment and purification water,
Filtering medium to separate suspended and colloidal substances,
Removal of inert loadings (quartz, quartz sand, screenings of granite, burnt rocks) etc.,
It increases protective barrier of water treatment services without capital investments to reconstruct structures,
Fine treatment from oil products,
Removal of iron, manganese, chrome, heavy non-ferrous metals (copper, zinc, lead, nickel, cadmium, etc),
An increase of the efficiency of structure work on the account of decreasing rinsing water volumes up to 60%, an increase of filter cycle two – three times,
An increase of the efficiency of structures by 20- 30% without capital outlays,
Decrease of reagents consumption (coagulates, flocculates) on keeping water quality,
The protective barrier when technological failure occurs: oil products, radioactive nucleus,
«Sorbent AS» adsorbent is widely used at the works of the Urals – Siberia region, Moscow region. Republic Uzbekistan and South Vietnam.

All deliveries for customers are done on FOB conditions by railway transport in polypropylene bags, in containers of 20, 24, 40 tons capacity, by goods vans.

Yours faithfully,
D.D. Ryzhov
Director
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«Sorbent AS» Sorbent and Its Utilization in the Systems of Drinkable Water Treatment and Purification of Reclaimed Cycle of Industrial Enterprices.

Industrial production of filtered material possessing absorption characteristics of «Sorbent AS» type on the basic of natural mineral raw materials started in 1998. In contrast to natural reolties having framework structure and ultraporosity which defines the reolite property proper as molecular

sieve which accounts for 0.34 of free intercrystalline volume for clinoptilolite, «Sorbent AS» sorbent possesses an internal volume up to 0.65 sm^3/g.

«Sorbent AS» sorbent possesses a number of advantages. It is safety and doesn't produce toxic compounds, insoluble in neutral and alkali media, possesses high resistance to attrition and grinding during the filtering process and radiationresistant. According to the conclusion of the Experimental Centre of Gossepidnadzor of Sverdlovsk region toxicity of water allowance is 83.9 % in comparison with the normal one – within the range of 70 – 120 %. Radiological experiments proved «Sorbent AS» safety and conditional effectiveness of natural radioactive nucleus is 60 – 80 Bk/kg, specific activity of Ra is not more than 0.4 Bk/kg. Data received during the experimental procedures of CWL Ekaterinburg – Vodokanal concerning mechanical strength and filtering capacity are given in Table 1.

Table 1

Index	Norm	Value
Density of dry material, g/cm^3	not normal	450 - 490
Density in wet condition, g/cm^3	For sorbents is allowed less 1500	1300 – 1400
Intergranular porosity, % Maximum Minimum	Not less 40.0	52,0 – 46,0
Grindability, %	Not more 4	0.14
Attrition, %	Not more 0.5	0.06
Tentative mechanical strength, %	Not more 1.0	0.79

The filter cycle for loading consisting of quartz sand is 24h, while that of «Sorbent AS» with the filtering rate – 5 m/h. duration of the filter cycle is 37hrs taking into account the rate of filtering 10 m/h with quartz sand loading which that of «Sorbent AS» – 62 hours, the filtering rate being the same.

Washing intensity providing the necessary relative widening of the loading was for quartz sand – 17.8 $l/s*m^2$, for «Sorbent AS» – (6.5 – 7.5) $l/s*m^2$. From the data presented above it is vividly seen that removal of the traditional loadings in filters for purification reclaimed cycles by «Sorbent AS» for sorbent will allow to economize clean water when filters are cleaned by increasing their efficiency and electric energy on the account of reducing the volumes of water used for purification and so on.

«Sorbent AS» is a very effective and economical loading which is used to remove the compounds of iron and manganese soluble in water providing high quality filtering and it is very easily cleaned from settled particles by means of reclaimed cleansing.

«Sorbent AS» is dereagentized sorbent and to restore its filtering capabilities reclaimed cleaning by water is sufficient.

To increase the effectiveness of water purification water treatment is used during which water is saturated by oxygen from air. To provide the necessary quantity of oxygen air ejector or compressor is used. «Sorbent AS» is dewatered alkali aluminosilicate and is a very effective means to remove insoluble and suspended particles from water. Due to irregular forms of its particles and their rough surface it is able to filter off the mechanical impurities of 20-40 micron from water.

It restores its filtering capability under reverse washing and doesn't require chemical regeneration. «Sorbent AS» is characterized by less pressure drop on the layer in comparison with many other filtering media. Due to its small specific weight less rates are required for reverse resulting in less water consumption for regeneration. High performing rates allow more

compact equipment to be used. In comparison with quartz sand its work efficiency increases nearly two times. It possesses a number of advantages compared to other filtering charges which are used usually to remove suspended particles and in its turn, requires less water flows for reverse washing and it can be used in both pressure and gravitation systems of water purification.

Advantages of «Sorbent AS» sorbent consist in:

- minimum pressure losses in comparison with most filtering chargings,
- very little water flow magnitude on reverse due to light particle weight,
- more low equipment cost and less area occupied due to high rates of flow in service conditions,
- high mud capacity of the charging resulting in more duration period of filter work by decreasing maintenance costs, water consumption used and service time,
- light transporting weight,
- providing an increase of mud filter capacity up to 100 % on replacing sand by the sorbent proper,
- filter for iron removal is used to remove suspended particles of trivalent colloid iron, oxidation of bivalent iron in its trivalent form with its further removal.

The principle of filter operation is based on filtering out the above mentioned impurities by means of porous filtering materials surfaces.

Oxidation of soluble ions of iron takes place by means of saturation of initial water by oxygen from air under pressure. One of the advantages of the filter is its reliability and that the chemically are not involved in the process of its work both on deironing and under periodic regeneration (reduction) of the filtered mass. It's a very effective means for removal impurities mentioned above with a small prime cost including minimum cost of handling labour. The decrease of iron content is 95 – 96 %.

In accordance with its properties the sorbent in question is for charging of light filters in the system of industrial water supply as the removal of filtered layer of double layer (anthracite – quartz) pressure or gravitation filter.

Sorbent is very efficient for tertiary treatment of sewage waters of the main and auxiliary shops of metal production including clean cycles at motor deports, oil tank farms, locomotive sheds, etc., to remove inert charging in high – rate trickling filters.

To charge high – rate trickling filters quartz sand and hydroantracite were and are used traditionally, but similar inert materials cannot increase the efficiency of filtering structures (the protective role).

Over – pumping of water is the most power - intensive procedure (operation) and as it is known prime cost of water purification is up to 20 % which constitute energy expenses (Russian practice). That's why a very intent attention to the problem under discussion may result in considerable and fast money saving.

One of the ways to decrease power intensity in the operation (work) described is to use chargings (loadings) with less bulk density compared to quartz sand and crystal quartz used traditionally (1600 – 1650, 1250 – 1350 kg/m^3).

Less intensity of cleaning filtered body will enable apart from the volume increase of cleansing water to be decreased considerably to lower the shift of gravel layers. So, zones with different hydraulic resistance at the area of filtering works are removed and as a consequence the causes of the worsening of the filtrate quality are removed, too.

Practically it was shown that the use of «Sorbent AS» sorbent the filter capacity ncreases up to 80 % (compared to filter filled in by quartz sand), the indices of cleaning being stable.

1. So, «Sorbent AS» sorbent will allow productivity growth to be increased in the volume of 60 – 80 % (that is, to create capacity reserve of water intake) compared to the filter loaded quartz sand.
2. By increasing the duration period of filter cycle in 2 – 4 times up to the next cleaning of «Sorbent AS» filter (in comparison with the filter loaded with quartz sand) will enable to decrease sharply the consumption of filtered water for the needs of water – intake works proper by 2 – 4 times of the present ones at the expense of the shortening of the number of cleanings.

3. Time of filter cleaning with «Sorbent AS» charging and accordinly the volume of cleaning water are decreased up to 45 – 60 %, (the intensity of cleaning is 6.5-7.5 l/s*m^2) in comparison with sand filter.
4. Indices of filtrate quality are in good agreement with the present standards even in

the most severe working conditions, the rate of filtration being raised up to 15 – 17 m/h, i.e. more than 2 – 3 times.
5. The mechanism of water filtration differs greatly from that of through quartz sand.
6. Accumulation of mechanical impurities both in structure and on the grain surface does not occur.
7. Regeneration of «Sorbent AS» sorbent doesn't require any special reagent treatment.
8. Mechanical wear rate permits the filter to work contantly up to the scheduled repair (not less than 5 years).

«Sorbent AS» is effectively used to clean alkaline flows from heavy non – ferrous metals with simultaneous correction of water pH and for cleaning of mine lime dump waters.

When using «Sorbent AS» sorbent under review to purity the water at the works will allow:

- to improve the quality of water with minimum expenditure by replacement of less effective filtering materials,
- or to decrease expenditure for nature protection by means of lowering payments on dumping and pollution of water resources,
- to replace expensive sorbents,
- to decrease water consumption by using closed circuits, i.e. systems excluding dumping industrial sewage waters in water objects,
- to decrease dosing or to refuse to use reagents (coagulates) which lead to unuse of the dosing out process and control over reagents and removal the whole complex of impurities in water.

Investigation carried out with the specialists of the Urals State Technical University confirm high technical characteristics of «Sorbent AS» sorbents. Having specific surface of 100 – 120 m^2/g absorption of heavy non – ferrow metals, radioactive nucleus, and organic compounds is higher than that of activated (active) carbons having the specific surface 500 – 700 m^2/g.

Partition coefficient on radioactive cesium is equal to 10^3 - 10^4. It is determined that the absorption equilibrium time is 1 – 1.5 hours. It is found that the mixing intensity absorption system doesn't affect the rate of absorption equilibrium rate.

The absorption system of cesium137 of drinkable water in static and dynamic conditions with the application of absorption – filtration «Sorbent AS» material has been studied. To define the degree of absorption (S, %) and partition coefficient (Kd, ml/g) of indicators quantities of cesium 137 the following procedure was carried out in accordance with the technique proper. In the solution tested having the volume 50 ml with the concentration of stable cesium 0.01 mg/l radioactive cesium 137was introduced and the calculated quantity of sorbent was introduced, too. Sorbent was kept in contact with solution some time which was necessary to active absorption equilibrium. Initial water had an activity on cesium 137 which was equal to 4 – 370 Bk/dm^3.

The dependences of cesium 137 extraction degrees from tap water of different composition upon the time of absorption equilibrium and sorbent mass were got. It is stated that preliminary cleaning of tap water with the help of membrane (reverse osmosis) doesn't influence practically kinetics of the extraction of radioactive nucleus. The degree of cesium 137 extraction which is equal to 95 – 98 % occurs when the specific weight of sorbent is 8 mg/ml in the solutions investigated. The time of the absorption equilibrium establishment for system with top water and water which has passed through membrane is 50 – 60 minutes.

To our mind, the resuets obtained, namely, insignificant influence of the investigated water composition on the cesium 137 extraction are connected with the nature of absorption interaction of sorbate and sorbent. In the systems under study such interaction is due to the forces of physical sorption. In this the very case completitive influence of the impurities present in water phase does not influence the radioactive nucleus extraction. Partition coefficient of cesium 137 is 2-3 * 10^3 ml/g between solid and liquid phases in the systems under discussion.

Low value of the filtrate residual activity (the order of 0.1 %) testifies about high selectivity of «Sorbent AS» to radioactive cesium. During the experiment we didn't manage to achieve the moment of the filter activity growth that refers to high possibilities of «Sorbent AS» to extract radioactive nucleus.

Filter – sorption «Sorbent AS» material is a highly effective material to solve problems connected with removal of oil product out of industrial sewage or reclaimed waters especially during combined removal with iron, and heavy non – ferrous metals.

Sorbent capacity in oil products in dynamic conditions is not less than 90 ml/l of sorbent under working indices 120 – 180 ml/l of sorbent.

Sorbtion of oil products according to the data of CWL Ekaterinburg – Vodokanal is the following:

Initial concentration – 0.68 mg/l
1. Filtration rate - 1 m/h
Residual content - 0.0028 mg/l
2. Filtration rate - 4 m/h
Residual content - 0.0028 mg/l
3. Filtration rate - 8 m/h
Residual content - 0.0028 mg/l

For purification of water flow, of technological water from radioactive nucleus «Sorbent AS» is of obvious interest. Economy of means is achieved to a considerable extent on the account of utilization of less expensive sorbents to deactivate water, namely, during purification of low active and of medium activity liquid radioactive wastes, e.g. water of condensates of gas purification systems, water of basins stand at heat power stations (HPS).

The experiments carried out allowed us to determine that sorption of copper which is one of the most difficult to be removed and the dangerous enough exceeds sorption with absorbent carbons «Filtrasorb 200» grade of coals in particular. It is established the degree of copper extraction with the initial concentration of 5 mg/l is 99.9 %. For comparison the degree of extraction of copper with same concentration by means of absorbent carbons is only 73 %. Sorption equilibrium in the system in which absorbent carbon is involved is reached during a long period of time. In this case it is necessary to point out that in this case the utilization of granules of 0.7 – 1.2 mm in size is the most effective one. Partition coefficient of copper among solid and liquid states is $0.9 – 8.2 * 10^3$ ml/g.

Oil capacity in the dynamic regime is 120 – 180 ml/g of sorbent, the height of the sorbent layer and its granulometric composition being the decisive factor.

Sorption potentialities are illustrated by the examples of oil products and heavy non – ferrous metals.

1. Lead sorption.
Initial concentration – 0.317 mg/l
Filtration rate – 2 m/h residual content – 0.0011 mg/l
Filtration rate – 5 m/h residual content – 0.0014 mg/l
Filtration rate – 10 m/h residual content – 0.001 mg/l

2. Manganese sorption
Initial concentration – 3 mg/l
Filtration rate – 3 m/h residual content – 0.0057 mg/l
Filtration rate – 5 m/h residual content – 0.0074 mg/l
Filtration rate – 7 m/h residual content – 0.0087 mg/l
Filtration rate – 10 m/h residual content – 0.0096 mg/l

3. Sorption of oil products
Initial concentration – 0.68 mg/l
Filtration rate – 1 m/h residual content – 0.0028 mg/l
Filtration rate – 4 m/h residual content – 0.0028 mg/l
Filtration rate – 8 m/h residual content – 0.0028 mg/l

4. Zinc sorption
Initial concentration – 5.12 mg/l
Filtration rate – 2 m/h residual content – 0.16 mg/l
Filtration rate – 5 m/h residual content – 0.20 mg/l

Filtration rate – 10 m/h residual content – 0.32 mg/l

Our experiments have shown that capacity to absorb truly soluble components sorbents show only when pH is not more 7. Sorption capacity of sorbents increases sharply when pH is in the range 7 – 12 reaching the value 0.5 mg. equivalent/g. Simultaneously, sorbent layer can absorb colloids and suspensions, their total absorption being 1 – 1.7 g per 1 g of sorbent. Really soluble components are sorbitized by mechanism of ion exchange whereas colloids and suspensions are sorbitized by the mechanism of contact coagulation with further filtration through the sorbent layer.

Sorption properties of sorbent are revealed in general on account of micropores having steepness of radius 5 – 20 A, macropores stepness of radius 500 – 5000 A. The total volume of pores reaches 0.7 cm^3/g being not inferior to home grades of active coals by this index. Bulk mass of sorbent is 680 – 720 kg/m^3 which results in decreasing the loading mass twice, intensity of cleaning 1.5 times by rising flow of water, decreases the quantity of cleaning water by two times compared to traditionally used quartz and quartzites, increasing filter cycle twice.

Filtering through «Sorbent AS» sorbent allows additionally organoleptical water characteristics to be improved, to decrease the heavy non – ferrous metals concentration iron, manganese, chrome, aluminum, organic compounds, phenol in particular, residual active chlorine, suspended agents and to correct pH of water.

According to the data of the Institute of Oil Chemistry of Siberian Branch of the Russian Academy of Sciences, the Tomsk city, when studying adsorption of oil products of the sampled oil emulsions from Sovetsky site of PLC Tomscneft and actual sewage waters of the locomotive shed named Taiga station in comparison with fibre polymer materials and the carbon ones the following conclusions have been made: «so, taking into account lower cost of material compared to polymer and carbon materials it is advisable to use the suggested adsorbent to purify technological wastes consisting of oil. When waters polluted with heavy non – ferrous metals are filtered with «Sorbent AS» sorbent a very high degree of purification is achieved, up to 96 %. The mechanism of filtration is supposed only. In the first layers of adsorbent the sample is greatly alkalized, metals form insoluble hydroxidy, which are mechanically filtered off by the further layers of «Sorbent AS» adsorbent. When the initial zinc concentration is 5.0 g/l, the filtrate consisted of 0.5 g/l, the content of iron was decreased from 5.2 g/l to 0.3 g/l»

The process of modernization of complexes for preparation and purification of water at the water drinkable supply facilities and industrial enterprices up to modern indices can be carried out without substantinal capital coast in a very short period of time and with real economical profit.

The utilization of «Sorbent AS» sorbent is one of the ways in achieving such goals.