The process of creating of 3D-models has ceased to be difficult and time-consuming. Furthermore, now it is more economical and allows increasing significantly the flexibility of production. Moreover, it reduces the number of technological processes in production.

The use of this technology is especially important in mobile and rapidly developing IT-industries because the equipment for such production can be easily transported and operated. This technology allows producing an original product – machine parts or components of a piece of equipment – in any conditions.

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APPLICATION OF POLYACRYLAMIDE IN MODERN WORLD

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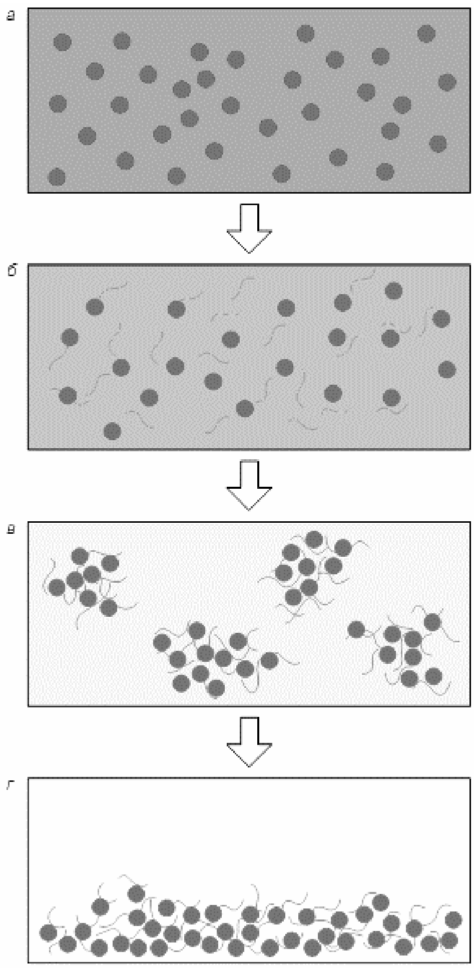
This article is about the industrial application of such a perspective material as polyacrylamide.

Currently ecology becomes a strategic industry, affecting on all spheres of political and economic prosperity of the state . Natural resources, quality of life, health and life span and even future of the country – all of them depend on the ecological situation of the environment.

Protection of the environment from pollution is one of the major problem of modern society. Environmental pollution can be primarily seen in the quality of surface and groundwater that is used in water supply. The organoleptic and chemical properties of water deteriorate from the inflow of wastewater, stormwater and meltwater [1].



This happens due to the change in the structure of industry, physical and moral deterioration of sewage treatment plants, absence or lack of funds from enterprises, the weakening of control over their water protection activities.

In this regard, in the 21st century the main strategic direction of reconstruction of water supply for industrial enterprises is the creation of closed water systems, which is impossible without alteration and improvement of existing treatment facilities and introduction of advanced technologies and equipment. New perspective methods of wastewater treatment are flocculation, sorption, membrane and oxidative methods [2].

Among the effective ways of intensifying existing technologies of natural and waste waters purification is the use of high-molecular flocculants alone or together with inorganic coagulants. Only due to the widespread introduction of physico-chemical treatment of industrial wastewater using coagulants and flocculants can provide effective 97-98 % removal of colloidal and finely impurities such as oil, grease, dyes, surfactants, etc.

Now a little more about the process of flocculation. Flocculation is the process in which the contamination particle of wastewater and high molecular weight substances (flocculants) interact. Thus, during the flocculation process takes place flocculation (macromolecular substances react with particles in the purified wastewater) and three-dimensional aggregates (flocs, complexes) are formed [3].

The adsorption process occurs in two stages [4, 5]. First, each macromolecule attaches with several segments to a single particle (primary adsorption). Then, free segments fix on the surface of other particles linking them with polymeric bridges (secondary adsorption).

The picture 1 shows a schematic diagram of the binding of the dispersion particles.

Acrylic amide polymer (AAP) is the best substances for all this requirements.

The AAP was obtained for the first time in 1893, but due to poor resource base the development of its industrial production began only in the early 1950s. The AAP has an ability to polymerize in the presence of radical initiators and possesses multipurpose properties. That ensured the rapid establishment and expansion of the production of polymers. Initially, these polymers were used as flocculants for sedimentation and filtration of phosphate sludge processing technology of uranium ores and strength additives for paper, and later became widely used in various industries, agriculture and medicine as flocculants , thickeners , adhesives , lubricants, nucleators, and film formers. Despite the wide range of important civilian applications of the AAPs, their use in the defense industry has substantially limited the availability of scientific information about them. As a result, until the early 1970s there was little information in the literature on the production technology of polymers. In recent years, with improvement of the resource base it has been created a scientific base for the targeted development of polymers with desired properties, developed advanced methods for the synthesis of polymers – polymerization and copolymerization of acryl amide in concentrated aqueous solutions and dispersions. Methods of chemical modification of polymers have been developed. Currently the AAPs are produced by large firms in the U.S., Japan and many developed countries in Europe. They are the main suppliers of polymers on the world market, and in Russia, China and South Africa polymers are produced only for domestic consumption. The production of the AAP continues to grow steadily and by the end of the century is going to reach 400 thousand tons per year. However, growth rates do not satisfy the needs of production, which increases annually by 8 – 10%. It is, therefore, relevant to develop new and improve existing methods for the synthesis of perspective the AAP, its derivatives and copolymers of AA.

The AA polymers possess a unique set of useful properties and are widely used in various fields of engineering and technology. Now a few worlds about different applications and usages of polymers.

The AA water-soluble polymers are widely used as flocculants for efficient purification of natural and industrial wastewater, capture and release of ions of heavy metals and toxic substances. Their use contributes to environmental protection, and in particular the protection of natural waters [6]. The effective bonding of settling particles is promoted by the increase of the size of macromolecules in an aqueous medium as a result of increasing the ionic content of the molecular weight and the links in the chain. Small additions (0.02%) of partially hydrolyzed AAP are used in water reservoirs, irrigation ponds and swimming pools to decrease (up to 14%) the evaporation rate of water. Experts predict that in the future environmental degradation will inevitably cause the increase of polymer use for the treatment of natural and industrial wastewater. The AA polymers are also successfully used as flocculants in medical, microbiological and food industries, e.g. for the purification of sugar syrups and fruit juices.

One of the traditional application areas of the AAP is pulp and paper industry. Used as a pulp binder, the AAP additives help to retain filler and pigments in the wet and dry pulp and improve the structure of paper sheet surface and paper properties. For example, partially hydrolyzed AAP additive (2 – 23% hydrolyzation at pH 6 – 9) increases retention of the kaolin in the paper pulp by 30 – 35% [7].

Introduction of small additions of the AAP in water (0.001%) for cutting marble doubles the efficiency of a water jet cutter. The cutting effect of the water jet is similar to that of sand and water mixture, but does not destroy pipes and pumps of plant. Dust particles treatment with aqueous solutions of partially hydrolyzed AAP is successfully used to reduce dust in coal mines, refineries, asbestos plants, and during drilling.

Currently, due to the worsening energy crisis the AAP are becoming important in the oil industry. In this field, the polymers are used for different purposes. For instance, the polymers are used in the process of drilling as stabilizers, filterability regulators, boring accelerators, rock and soil forming agents for strengthening the walls of the well. During secondary oil production the AAP additives reduce the mobility of water injected into the reservoir, which helps to displace oil from porous rocks. Derived anionic and cationic AAP are used for the creating of aquifer protective screens and decreasing of water content in the produced oil. Aqueous solutions of the partially hydrolyzed AAP (with molecular weight = $(3,5 – 8) \cdot 10^6$ and the degree of hydrolysis of 1 – 30%) for the treatment of 400 wells over six years have yielded a profit of 2400%. The use of 1 ton of the "Temposkrin" reagent in the secondary oil production, obtained on the basis of AAP, can provide the extraction from a borehole of extra 1200 – 1500 tonnes of oil [4, 7].

Summarizing, we can say that today the leading position in producing and using belongs to such polymers as polyamides, acrylic and polyacrylic acid, a variety of analogues based on them. The reason for this, apparently, is the high effectiveness of this reagent, combined with the desired hydrophilicity, relatively low toxicity against lower animals. Relatively easy production of basic polymers (polyacrylamide, polymethyl methacrylate), universal and simple ways to modify them are also important factors for their wide use.

However, there is no AAP production on the territory of the Republic of Belarus, which makes actual the subject of the study. The existing technology of producing monomers on the plant"Polymir" of the JSC "Naftan" allows the production of acrylonitrile, which, in its turn, can be used for the production of polyacrylamide. Therefore, the aim of further research is to find the technology for industrial producing of AAP in Belarus.

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MUNICIPAL UTILITY WATER TREATMENT

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For more than 20 years there has been remarkable growth in the need for quality water purification by all categories of users – municipal, industrial, institutional, medical, commercial and residential. The increasingly broad range of requirements for water quality has motivated the water treatment industry to refine existing techniques, combine methods and explore new water purification technologies.

Water treatment can be defined as any procedure or method used to alter the chemical composition or natural "behavior" of a water supply. Water supplies are classified as either surface water or groundwater. The majority of public or municipal water comes from surface water such as rivers, lakes, and reservoirs. The majority of private water supplies consist of groundwater pumped from wells.

Most municipal water found in a city or community today has been treated extensively. Specific water treatment methods and steps taken by municipalities to meet local, state, national, or international standards vary but are categorized below [1].

Screen prefiltration. A coarse screen, usually 35 to 140 microns, at the intake point of a surface water supply, removes large particulate matter to protect downstream equipment from clogging, fouling, or being damaged.

Clarification. Clarification is generally a multi-step process to reduce turbidity and suspended matter. Steps include the addition of chemical coagulants or pH-adjustment chemicals that react to form floc. The floc settles by gravity in settling tanks or is removed as the water percolates through a gravity filter. The clarification process effectively removes particles larger than 25 microns. The clarification process is not 100% efficient; therefore, water treated through clarification may still contain some suspended materials.

Lime-soda treatment. The addition of lime (Ca) and soda ash (Na_2CO_3) reduces the level of calcium and magnesium and is referred to as "lime softening". The purpose of lime softening is to precipitate calcium and magnesium hydroxides (hardness) and then clarify the water. The process is inexpensive but only marginally effective, usually producing water of 50 to 120 ppm hardness.