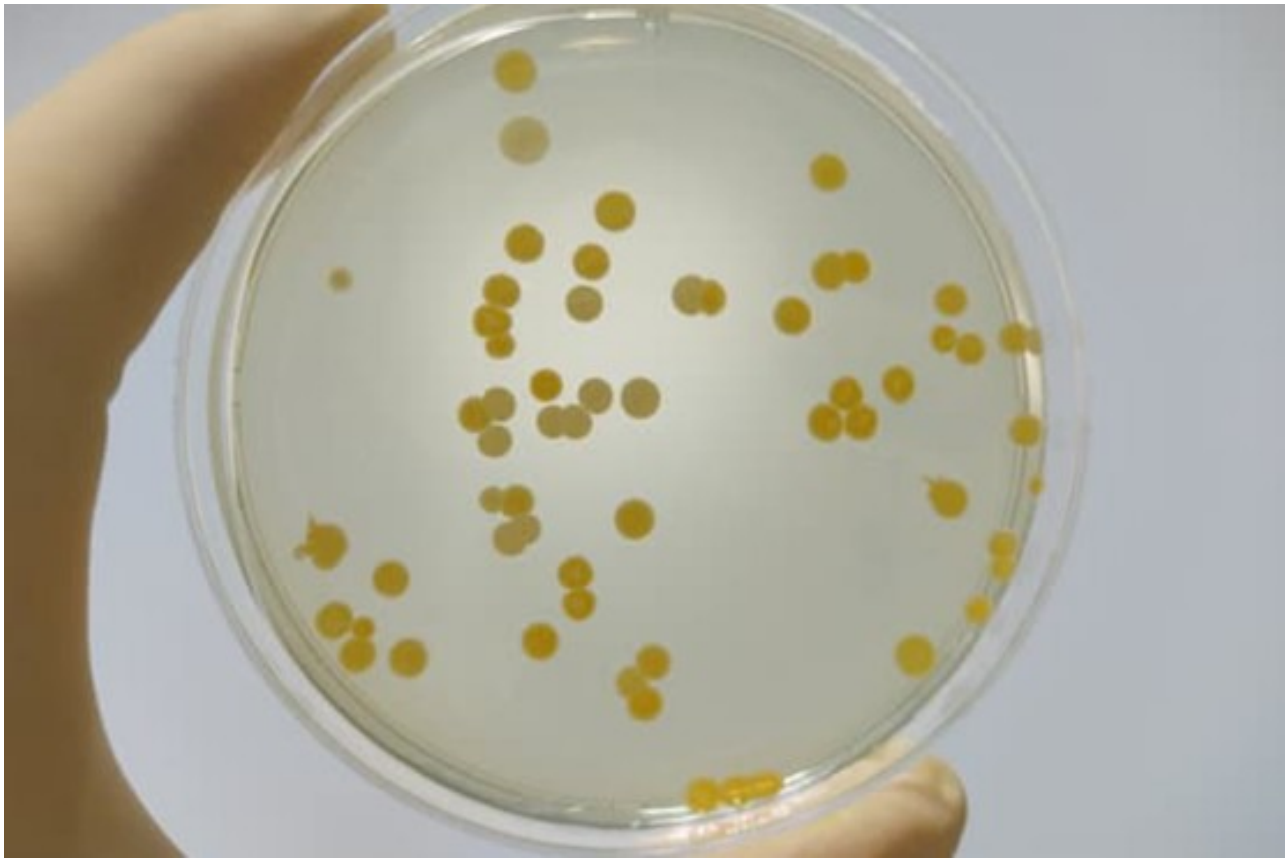
Synthesis of new polyacrylamide emulsion and its application in oilfield

Synthesis of new polyacrylamide emulsion and its application in oilfield by {corporation} , we provide latest information about the products regularly.

The new polyacrylamide emulsion, also known as "water-in-water" type polyacrylamide emulsion, synthesized by the dispersion polymerization method, has the advantages of fast dissolution, easy use in the field, and being friendly to the environment. Indoor tests have shown that this emulsion can be fully dissolved within 15 min at room temperature. In comparison, dry polyacrylamide powder takes 40 min at the earliest. Preliminary Research on offshore dissection technology was carried out for the characteristics of offshore oil field development. The polymeric jelly dissection system consisting of anionic polyacrylamide emulsion phenolic pre-condensation crosslinker with molecular weight (6-8) × 106 and 20% hydrolysis degree can be prepared directly from seawater with pH 8.3 and mineralization degree 31107.12 mg/L. The dissection system can be used at a high mineralization level. The dissection system is rapidly dispersed and dissolved in highly mineralized seawater. The freeze-forming time is adjustable from 3 to 10 d at 70°C. The freeze-forming strength is high enough to form an effective seal on the high permeability layer, which basically meets the dissection needs in offshore oil fields. The emulsion is also expected to be used in many areas of oilfield development, such as oilfield sewage treatment, anti-sand swelling, acidification, anti-wax, and anti-scaling.



Polyacrylamide is a versatile and highly effective water-soluble polymer widely used in water treatment, paper making, textile printing and dyeing, mining and metallurgy, medicine, oil and gas field development, etc., attracting and more attention. In oil and gas field development, polyacrylamides play an essential role in polymer drive, water conditioning and blocking, sand control, recovery effluent treatment, acidification, etc. However, the current polyacrylamide dry powder dissolves slowly with a long swelling phase. It requires considerable dissolution and maturation equipment, which takes up a lot of space and is limited in particular sites such as offshore platform operations. The dispersion polymerization method synthesizes polyacrylamide emulsions with excellent dissolution properties, which are easy to use in the field and environmentally friendly, and have a wide range of applications in oilfield development.

Dispersion polymerization is a relatively new method of polymerization originally proposed by ICI in the 1970s. Dispersion polymerization usually refers to a polymerization method in which the monomer has good solubility in the dispersion medium. The resulting polymer is insoluble in the dispersion medium and stabilized by stabilizers. The system's stability is achieved by the adsorption of amphiphilic polymer stabilizers or graft stabilizers present in the continuous phase on the surface of the polymer particles. The main components of the dispersion polymerization system are the monomeric dispersion medium stabilizer and initiator. Compared with other polymerization methods, the dispersion polymerization system has low apparent viscosity, fast dissolution rate, low heat of evaporation of the medium, simple production process, and a wide range of functional monomers, etc. Therefore, this polymerization method has attracted much attention from scholars at home and abroad in recent years. Since acrylamide is a water-soluble polar monomer, the surface energy of the ions formed is high, and the reaction conditions, especially the requirements for dispersants, are demanding. Research on the dispersion polymerization of acrylamide began in the late 1990s and generally used two systems: low carbon alcohol/water mixtures [and brine solutions. Polyacrylamide synthesized by dispersion polymerization is also known as "water-in-water" polyacrylamide emulsion. Experts define "water-in-water" type polymer emulsion as one or several water-soluble monomers in a solution of a water-soluble polymer to produce another water-soluble polymer under certain conditions the two keys of water-soluble polymers are immiscible in which one polymer and the hydrated water it carries as a continuous phase (outer phase) wrapped around One polymer and the hydrated water it has as the continuous phase (external phase) are wrapped around another polymer and its hydrated water as the dispersed phase (internal phase). Because both the internal and external phases are aqueous. The two steps are not miscible; they are called "water-in-water" emulsions.

Many fundamental types of Research have been conducted on the synthesis of polyacrylamide emulsions by dispersion polymerization, mainly on the kinetics of nucleation and stabilization mechanism of polyacrylamide dispersion polymerization and the factors influencing the polymerization reaction.

Currently, two leading dispersion media are used to synthesize polyacrylamides by dispersion polymerization: water and alcohols as reaction media and brine as reaction media. Stability is a crucial indicator for the synthesis of polyacrylamides by dispersion polymerization. Since the central role of dispersants is to stabilize the polymer, it is important to find cost-effective dispersants. It is generally accepted that the higher the concentration of dispersant in a

dispersion polymerization system, the smaller the nuclei formed; the more significant the specific surface area, the greater the probability that monomers will be adsorbed into the particles and the higher the molecular weight and smaller the particle size of the resulting polymerization product. Commonly used dispersants are polyvinylpyrrolidone (PVP), polyvinyl methyl ether (PVME), etc. The widely used dispersants are expensive, and the concentration of monomers for dispersion polymerization is low. Therefore, researchers have synthesized several better dispersants such as copolymers of poly(trimethylammonium chloride) ethyl acrylate (PAOTAC), poly(vinyl methyl ether) (PVME), and maleic anhydride (MA). In addition, the composition of the dispersion medium, initial monomer concentration, initiator, reaction time, and polymerization temperature have influenced the stability, dissolution rate, microsphere size and dispersion, monomer conversion rate, and relative molecular mass of polyacrylamide synthesized by this method. The optimization of the synthesis conditions has been extensively studied in China and abroad.

1, the use of homemade "water-in-water" type cationic polypropylene amide on its application in bleached wheat straw pulp retention effect Research and analysis of factors affecting the retention and filtration effect such as emulsion dosage stirring speed reaction time, salt ion concentration, etc. At the same time, it was found that the emulsion has a specific resistance effect on the accumulation of trash ions in the aqueous solution pH value on its retention aid. It can meet the needs of different paper-making processes such as acidic, neutral, and alkaline.

2. The laboratory synthesized a "water-in-water" polyacrylamide emulsion to bleached wheat straw pulp to consider its paper reinforcement effect. The results show that the polyacrylamide emulsion synthesized in the experimental enclosure has an excellent reinforcing impact when added at 1.0% (relative to the dry pulp), the tensile index, tearing index, and breaking resistance index of the finished paper increased by 28.4%, 41.5%, and 24.2%, respectively, compared to the blank sample. The experimental polyacrylamide emulsion was more effective in strengthening the paper than the commonly used paper reinforcing agents in the market. It can be added directly to the pulp to reduce the dissolution equipment of paper mills, thus reducing the cost of paper production and improving the economic efficiency of paper mills.

3. The use of indoor synthesized cationic polyacrylamide emulsion for wastewater flocculation shows that the synthetic cationic flocculant is used in combination with other methods such as anaerobic digestion to treat MSG wastewater and the removal rate of biological oxygen demand (BOD), chemical oxygen demand (COD) and the color is greatly improved.

4, the aqueous dispersion cationic polyacrylamide used in gentamicin sulfate pharmaceutical wastewater treatment. The results of field experiments show that compared with imported powder and colloidal pharmaceuticals, the dissolution speed of aqueous dispersion polyacrylamide is fast. The dosing amount is low, and the removal rate of suspended solids (SS) and chemical oxygen demand (COD) is up to 98.7% and 75.9%, respectively. The water content of the filter cake is the lowest. In addition, the treated wastewater fully meets the primary air flotation treatment requirements of the pharmaceutical plant, effectively reducing the load and operating costs of the subsequent treatment.

II. Prospects for application in oilfield development

1?Wastewater treatment

Flocculation and sedimentation is an economical and straightforward method for water quality treatment, which is widely used at home and abroad to improve the efficiency of water treatment. Polyacrylamides and their derivatives are an important class of synthetic organic polymer flocculants. Cationic polyacrylamide is a suitable flocculant that can achieve a variety of functions such as flocculation, coagulation, filtration, and clarification process efficiency. The effluent from oil wells contains crude oil, bacteria, suspended solids, and many other substances that need to be removed, sterilized, and flocculated to meet the requirements for re-injection or discharge. Polyacrylamide is a commonly used oil remover and flocculant in the field. Due to the poor solubility of dry polyacrylamide powder, it is necessary to configure the polymer dispersion device on-site, which takes a long time to operate.

2. Dissection and water plugging

As an effective means to improve the development effect of water drive in high water-bearing reservoirs, water conditioning and water plugging technology plays a vital role in oilfield water control and soil stabilization.

Polyacrylamide is one of the most used polymers for cross-linking in oil fields at home and abroad. In onshore oil fields, dry polyacrylamide powder is used for water conditioning and blocking operations, which usually requires several tens of cubic meters of liquid preparation and maturation equipment. It is difficult to place a large dissolution unit in offshore oil fields due

to the limited operating space. One is to dissolve the dry powder on land and then transport it to the offshore platform for construction. The other is to directly transport the dry powder to the venue, dissolve it on the forum, and carry out the building. Regardless of the construction process, the dissolution time required for polyacrylamide is relatively long, and the vessel rental cost is expensive. To overcome the shortcomings in the solubility of dry polyacrylamide powders, "water-in-oil" type polyacrylamide reverse-phase emulsions have been developed. Although the solubility of polyacrylamide has been significantly improved compared with dry polyacrylamide powder, the "water-in-oil" type polyacrylamide reverse-phase emulsion contains a large number of organic solvents or diesel fuel, which can cause environmental pollution and fires, and requires the addition of a steering agent during the use of the emulsion, which is highly inconvenient.

Considering that polyacrylamide synthesized by dispersion polymerization has good dissolution performance, is environmentally friendly, and is easy to use, the author believes it can be used in offshore oil and gas applications. The author believes it has a broad application prospect in offshore oilfield water conditioning and blocking operations and conducts a preliminary study.

The dissolution performance of three polyacrylamide emulsions synthesized by dispersion polymerization was compared. The effective polyacrylamide concentration was 0.4% in distilled water and measured at 20°C with a ZNN-D6 rotational viscometer at 300r/min with a shear rate of 511s-1.

3?Sand prevention and suppression

As oil and gas field development progresses, the water content of oil and gas wells continues to rise, and many oil and gas wells are becoming sandy and increasingly severe. Oil and gas wells are prone to sand burial in the oil and gas reservoir; pitting of pumping pump valve balls, valve seats do not seal; and may cause the sudden collapse of the formation resulting in damage or even the scrapping of the oil and gas wells, seriously affecting the average production of the field. The expansion of clay particles can block the throat and reduce the production capacity of oil and gas wells, so it is necessary to prevent the growth and transport of clay particles.

Cationic polyacrylamide is a commonly used organic anti-sand bridging agent and clay swelling inhibitor. The same effect can be achieved with polyacrylamide emulsions synthesized by dispersion polymerization. The apparent viscosity is low, the fluidity is good, the dissolution speed is fast, and there are no lumps of insoluble material.

III. Conclusions and recommendations

Polyacrylamide emulsions synthesized by dispersion polymerization are fast dissolving, easy to use, and environmentally friendly. They have good application prospects in oil fields.

(1) Under the current technical and economic conditions, the polyacrylamide emulsions synthesized by dispersion polymerization method can basically meet the requirements of oilfield wastewater treatment, dissection and water plugging, anti-swelling, and sand suppression, etc. Preliminary studies have been conducted.

(2) At present, emulsion products are available in the market. Still, they are mainly used for water treatment and have a single purpose. It is necessary to serialize the new polyacrylamide emulsions for various needs in the oilfield and increase the Research on the supporting technology of field construction.

(3) Polyacrylamide emulsions synthesized by dispersion polymerization are expected to be used as scale inhibitors, wax inhibitors, additives for acidification, thickening agents, drag-reducing agents, etc., in the development of oil and gas fields.

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