

Study on Surface Hydrophilic Modification of Polymer Membrane

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Abstract

Membrane separation technology represented by polymer organic separation membrane has the advantages of high separation efficiency, low energy consumption and simple operation. It has become one of the important means of separation and purification, and has been widely used in the fields of energy, chemical industry and environment. However, on the other hand, they are easy to combine with the substances to be separated, especially organic substances and active biological substances such as oils and proteins in the membrane surface and pores, so that the membrane flux gradually decreases with the filtration process and the widespread application is inhibited. Therefore, membrane modification is needed to improve its performance.

Keywords

Polymer membrane, physical modification, chemical modification.

1. The Necessity of Surface Hydrophilic Modification of Polymer Membrane

Membrane is a kind of physical material with selective separation function. The process of separation, purification and concentration of different components of material and liquid by selective membrane separation is called membrane separation. It is different from the traditional filtration in that the membrane can be separated within the range of molecules, and this process is a physical process, without the phase change and addition of additives. The pore size of the membrane is generally micron, and the membrane can be divided into microfiltration membrane, ultrafiltration membrane, nanofiltration membrane and reverse osmosis membrane according to the pore size (or interception molecular weight). According to the different material, can be divided into inorganic membrane and organic membrane. The inorganic membrane mainly has the membrane of microfiltration grade, mainly is the ceramic membrane and the metal membrane; Organic membrane is made of polymer materials, such as cellulose acetate, aromatic polyamide, polyethersulfone, polyfluoropolymer and so on [1].

Membrane separation technology has the advantages of low energy consumption, simple process, high separation efficiency and no pollution to the environment. The key of membrane separation is membrane, which must have good selective transmittance, good chemical stability and certain mechanical strength. Polymer is the main material for making films because of its excellent properties, low price and easy processability.

However, hydrophobic polymer porous membrane in the treatment of the water system will produce a series of problems, such as higher cost through the membrane mass transfer driving force, high energy consumption, and the hydrophobic membrane is susceptible to protein with hydrophobic groups such as organic matter pollution, not easy elution and pollutants, the serious influence the service life of the organic film, limits the use of membrane materials, the main way to solve the above problem is to hydrophilization modified porous membrane surface [2].

2. Hydrophilic Modification of Polyethylene Film

Polyethylene is a polymer mass linear alkane synthesized by the polymerization of ethylene monomer. It is the largest production of plastic products, among which the amount of polyethylene film material is also increasing year by year. However, due to the lack of polar groups in the polyethylene chain, the surface free energy is low, and the cohesive energy density is low in the plastic material, resulting in the lower functional properties of polyethylene such as surface hydrophilicity, surface energy, wettability, chemical inertness, dyeing, adhesion and biocompatibility. Due to poor hydrophilicity, polyethylene film is easy to carry static electricity, easy to stain, poor biocompatibility and difficult to stain, so its application is limited. Therefore, people pay more and more attention to the surface modification of polyethylene film.

The purpose of surface modification of polyethylene film is to introduce polar groups on the surface of polyethylene to improve the surface energy and roughness of polyethylene film, so as to increase the surface bonding performance and eliminate the weak boundary layer on the surface, so as to further expand the application range of polyethylene film. There are many hydrophilic modification methods of polyethylene, which can be summarized as physical methods and chemical methods. Chemical modification means to endue hydrophilic groups by copolymerization and grafting of materials, mainly including surface chemical oxidation, ultraviolet grafting and surface plasma treatment.

2.1. Physical Modification Method

Blending modification is one of the physical modification methods: with polyethylene as base material, and mixed with different polarity small molecule [9], after mixing machine blending made corresponding polyethylene film, forming small molecules polarity slowly migrated to the PE base material surface, make its surface affinity increased, and then for water treatment, radiation treatment, radiation, further improving strength after alkali treatment, etc.

Surface coating, in essence, is the selection of hydrophilic materials for the surface coating or impregnation of polyolefin film, so as to obtain hydrophilic, hydrophilic materials including surfactants, alcohols. The properties of the film obtained by surface coating depend on the properties of the supporting layer, the composition of coating liquid and the reaction conditions. Although the operation is convenient, but the obtained hydrophilic, has a very obvious timeliness, not lasting. There exists the problem of high organic matter content in the initial filtration water, and the hydrophilic layer is very easy to be eluted when treating the water system.

Surface embedding method of polymer carrier surface area by solvent swelling (not dissolve), solvent modifier by solution blending effect of the surface of the insert carrier swelling, swelling and swelling on the surface area rushed back, make the contracting carrier polymer molecular chain by winding embedding immobilized modifier in the molecular chain. Due to the insufficient solubility of the selected solvent, the swelling effect is limited to the surface area of the polymer carrier, and it is difficult to affect the polymer carrier itself, so the surface modification of the polymer is realized[3].

2.2. Chemical Modification Method

Surface chemical oxidation method, the principle is: the strong oxidizing substances on the surface of polyethylene, polyethylene surface molecules are oxidized, in the surface of the material with polar groups of carboxyl group, carbonyl group, sulfonic acid group; At the same time, the weak interface layer is destroyed or even the molecular chain breaks because it is dissolved in the strong oxidation treatment solution, so as to form dense pits, so as to increase the roughness of the material and improve the adhesion of the material. However, it is difficult to control the treatment thickness of polyethylene surface with strong oxidation treating agent,

and the treatment solution has certain pollution to the environment, so it is still difficult to achieve industrial production.

Ultraviolet photografting is an effective method suitable for surface modification. Surface photografting of polymers is the graft polymerization of monomers on the polymer surface induced by ultraviolet light, which follows the mechanism of free radical polymerization. Song et al. grafted 2- acrylamide -2- methyl sulfonic acid (AMPS) on polypropylene by ultraviolet grafting. The results showed that the grafting rate increased with the extension of treatment time and the increase of AMPS concentration, and the water contact decreased obviously. The contact Angle decreased from 124° before modification to 26°.

Plasma treatment, the main use of low temperature plasma in polyethylene modified the active particles bombarding material surface, make the material surface molecular bonds were opened, and the oxygen, nitrogen and plasma active free radicals, such as in polymer material surface containing oxygen, nitrogen and other polar groups, because the surface increases the lots of polar group which can obviously improve the adhesion on the surface of the material, printing, dyeing, etc. At present, the modification of plasma treatment mostly stays in the basic research stage of small area membrane treatment.

Various treatment methods are to improve the polyethylene film surface polarity, reduce the contact Angle, improve the surface energy, and various surface modification technology has its advantages and disadvantages. In summary, we need to find a relatively simple and feasible hydrophilic modification method of polyethylene, which does not damage the structure of the film, reduce the mechanical properties of the film, change the appearance of the film flatness and color, and can make it obtain good lasting hydrophilic.

3. Conclusion

Membrane pollution has always been a problem in the development of membrane industry. It is widely believed that the improvement of membrane surface hydrophilicity can greatly reduce membrane pollution. In order to improve the hydrophilicity of the membrane surface and improve the anti-pollution property of the membrane, researchers have done a lot of research work, including physical modification methods and chemical modification methods. The physical modification methods include blending modification, surface coating and surface embedding. Chemical modification methods include surface chemical oxidation, ultraviolet grafting and plasma treatment.

References

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