CONFERENCE PROCEEDING

Short Review : Advanced Water Treatment Technology

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ABSTRACT

Water treatment technology is one of the most important mechanism in our life. It turns unclean water into a clean and safely consumables by us. Over the years, research and invention over water treatment technology have progressed in terms of energy consumption, materials of interest, cost reduction, efficiency, land usage and mechanisms utilizing the concept of science around us. Conventional technology of water treatment can be categorized into physical, chemical, and biological treatments. Physical treatments include screening, filtration, sedimentation, flotation etc. Chemical treatment includes disinfection, precipitation, adsorption, ion-exchange, ozonation etc. Biological treatment involves aerobic and anaerobic biological treatments. However, there are new potential advanced technology being developed to clean our water in better way of many aspects. Among latest water filtration technology in water treatment interesting to discuss are nanotechnology, acoustic nanotube technology, photocatalytic water purification technology, aquaporin Inside^{TM} technology and automatic variable filtration (AVF) technology. In this paper, the application of advanced technology in water treatment is discussed in a brief manner with latest development and challenge reported in the literature. With this review paper, hopefully, it will shed some lights for newcomers that want to learn or to get overview about current development of nanotechnology in water treatment system.

Keywords: *Advanced water treatment, technology*

INTRODUCTION

Water filtration is the process of removing or reducing the concentration of particulate matter, including suspended particles, parasites, bacteria, algae, viruses, and fungi, as well as other undesirable chemical and biological contaminants from contaminated water to produce safe and clean water for a specific purpose, such as drinking, medical, and pharmaceutical applications. The filtration systems for drinking water usually incorporate a five-stage filtration process: sediment, mechanical, chemical, mineral, and bacterial (Kunduru *et al*., 2017).

With consideration of the requirements of avoidance of fibre shedding in the filtration process, nonwoven fabrics made from continuous fibres such as melt blown, spunbond, and hydroentangled nonwovens and electrospun/centrifugal spinning nanofibre nonwovens, as well as their composite combinations comprising both microfibres and nanofibres, are widely used in microfiltration as a water filtration media. They functions as either an independent microfiltration media or prefilters to remove a high contaminant content within the fluid to protect membrane filters.

In the water filtration system, membrane filters are highly efficient in filtering submicron contaminants in water, but have a deficiency of very limited filtrate holding capacity. Nanofibre nonwoven fabrics are widely used in membrane water filtration system as viral removal filters. They have two roles in the composite filter structure: they act as a separate prefilter to separate out particles of larger size than the rating of the membrane to promote the high filtration efficiency of membrane filters, and they also provide depth filtration to the membrane to improve the particle holding capacities of the membrane filtration system to extend the lifetime of the membranes.

Biofouling from bacterial, fungi, and other microorganisms in the water decrease nonwoven prefilter membrane performance and increase the frequency and cost of its chemical cleaning. There are many ways to make nonwoven filters antibacterial and biocidal. Water filters could be made to incorporate biocides, including quaternary phosphonium salt, polymeric phosphonium salts, and onium-functionalized polymers, into nonwoven filters to remove bacteria and other microorganisms.

WATER PURIFICATION TECHNOLOGIES AND ITS CHALLENGES

Nanotechnology

Nanotechnology refers to numerous methods and approaches of making use of substances at the atomic or molecular scale. Nanotechnology which based primarily on water purification approaches are taken into consideration to be modular, fantastically green and cost-powerful whilst in comparison to traditional water purification methods. Nanotechnology treats the water with the aid of making use of substances at the atomic or molecular scale (Shah and Mraz *et al*., 2020). The big surface-to-extent ratio of nanoparticles complements the adsorption of chemical and organic particles, permitting the separation of contaminants at very low concentrations. Nano adsorbents function particular bodily and chemical residences for the elimination of metal pollution from water (Lee *et al*., 2017).

The major applications of nanotechnology in water treatment approaches which includes nanostructured photocatalysts, nano-membranes, and nano adsorbents, silver, copper and zero-valent iron (ZVI) nanoparticles. Among the most nanomaterials utilized in water purification technologies is carbon nanotubes (CNTs). CNT which based primarily on total filtration structures can remove organic, inorganic and organic compounds from water. Drinking water remedy, such as using bimetallic nanoparticles, had been explored as opportunity water disinfection tools.

For example, how they are investigating nanotechnology-enabled water treatment processes, how they are reviewing our water supply and wastewater treatment, or how both organic chemistry and nanotechnology have been applied to the separation of water and oil. As well as how nanotechnology can replace traditional reverse osmosis (RO) membranes in desalination and water reuse applications by allowing materials to be touted as energy efficient (Tlili &Alkanhal, 2019). Not to mention on the enhancement in the use of nanoparticles and emulsion-based systems to prevent fish disease, nutrient delivery and purifying water (Hoek *et al*., 2014).

This is a new approach in water treatment systems where there is a significant need for new, state-of-the-art water technologies, in particular to ensure high quality drinking water, eliminate micropollutants and intensify industrial production processes through the use of flexibly customizable water treatment systems. Nano-adsorbents, nano-metals, nano-membranes and photocatalysts are examples of nanoengineered materials which offer the adaptive and potential of new water technologies.

Acoustic Nanotube Technology

Acoustic nanotube technology uses acoustics to direct water through small diameter carbon nanotubes instead of pressure. It was first discovered by scientists at NASA's Johnson Space Centre. Depending on the end user requirements, the system works by water entering the device and first comes into contact with the filter matrix, which may consist of polymeric, ceramic or metallic compounds. The carbon nanotubes contained in the matrix allowing only water molecules leaving larger molecules and contaminants behind (Gehrke *et al*., 2015).

The technology is considered unique because the use of acoustics in passing water through the filter. The acoustic vibrations propagated from an oscillator circuit which connected to the filter matrix which in turn cause the release of water molecules and their movement through the filter. It also removes reliance on gravity (and thus filter orientation) to pass water through the device. When the water leaving the system drops to a predetermined value, a cleaning cycle is activated to remove sediment from the filter inlet, restoring the system's standard flow rate and it does not required to flush. One example of nanotube acoustic technology is carbon nanotubes (CNTs) made of carbon with a diameter usually measured in nanometres. Nanotube acoustic technology applications are municipal water plants, medical facilities, laboratories, refineries, desalination plants, industrial plants, wastewater treatment plants and the consumer segment.

Existing water filtration technologies are generally high in energy consumption, and costs and constrained by limited performance. New filtration and treatment techniques designed to reduce this problem which rely most on pressure to guide water through the filtration system. The combination of acoustics and small diameter carbon nanotubes creates an effective and efficient way of producing clean and contaminant-free water. This innovation is scalable with the integration of multiple filters, based on the user's filtration needs Therefore, this technology is better than other traditional filtration systems for treating wastewater because it uses less energy and keeps water away from contaminants rather than removing pollutants from water (Xu *et al*., 2019).

Photocatalytic Water Purification Technology

In recent years, photocatalytic water treatment has become state-of-the-art technology due to its efficiency in treating contaminated water. This technology uses a photocatalyst and ultraviolet (UV) light to eliminates toxic substances in water (Gehrke *et al*., 2015).

Panasonic has developed a technology that binds a photocatalyst (titanium dioxide) to a commercial adsorbent and catalyst called a zeolite. The use of titanium dioxide is to mineralize various organic compounds into safe final products. This is to ensure an effective technique for separation and recovery of the photocatalyst from water for reuse.

Catalysts use sunlight or artificial light which contained UV radiation to separate substances. Photocatalysis can break down pesticides, crude oil, various organic materials, dyes, and microbes such as chlorine-resistant pathogens or inorganic compounds such as nitrogen oxides. Photocatalytic water treatment systems are suitable for use in water and wastewater treatment plants and can treat industrial wastewater polluted by many organic substances or metals which are major problems that happen nowadays.

Aquaporin Inside™ Technology

The Aquaporin Inside™ technology, invented by the Danish cleantech company, which based on the biomimetic design of a water treatment membrane. Aquaporins allow the membrane cell to regulate the volume and internal osmotic pressure as a function of the difference in hydrostatic and osmotic pressure. They allow rapid and highly selective transfer of water across cell membranes (Hoek *et al*., 2014).

Natural biomimetic membranes also serve as the basis for the development of artificial biomimetic membrane systems. This technology is widely used in industrial and domestic water filtration and purification systems.

Aquaporin Inside membrane is the only one on the market that uses aquaporin for water drinking purification. The Danish cleantech company commercializes its patented Aquaporin Inside™ technology in aerospace applications and space programs, in collaboration with European and US companies .

Automatic Variable Filtration (AVF) Technology

Automated Variable Filtration (AVF) technology provides a simple process in which the upstream. The system start off by pumping the feed water to AVF units and as the influential feed is introduced at the top, the feed will flows downward. The feed is introduced into the bottom of the media bed through a series of feed radials. As the influent flows upward through the downward moving media bed, organic and inorganic impurities are filtered by the media. The clean, polished filtrate continues to move upward and exits at the top of the filter over through the effluent pipe. A small volume of compressed air is introduced at the bottom of the airlift, drawing the media into the airlift pipe. The media is scoured within the airlift pipe. The effectiveness of this scouring process is vastly greater than what can be expected in conventional sand filtration backwash. The scouring dislodges any solid particle attached to the media grains. The dirty slurry is pushed to the top of the airlift and into the reject compartment. As the media cascades down through the concentric stages of the washer, it encounters a small amount of polished filtrate moving upward. The clean recycled media is deposited on the top of the media bed where it once again begins the influential cleaning process and its eventual migration to the bottom of the filter (Lee *et al*., 2017).

AVF is a low-cost, low-maintenance partner for membrane microfiltration technology. This process provides water of the same quality as microfiltration technology and at a lower cost than low-pressure membranes. It has no moving parts and consumes less energy, providing savings in operating and maintenance costs. AVF systems are suitable for drinking water and municipal wastewater treatment, wastewater recycling and reuse, prefiltration for membrane processes and desalination applications.

CONCLUSION

As conclusion, there are many wastewater treatment technology in our world. We need choose the best among them based on energy consumption, materials of interest, cost reduction, efficiency, land usage and mechanisms utilizing the concept of science around us. This paper can help other researcher to do their research that related to wastewater treatment technology.

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