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RESEARCH ARTICLE

WATER CRITICISM, OPERATIONS AND SOLUTIONS

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ABSTRACT

Water as air is an essential need of human and all creations on the earth. Industrial revolution, economical development and population growth also increase of water consumption is in a disappointed situation with regards to water supply. Some countries and Iran are in a bad situation in this aspect, annual rain in Iran is much less than mean value of the world and deserts cover much ands in our country. Therefore we should use all facilities and ways to solve drought problems. In this paper including an annual research results, the subject will be studied using new sciences such as nanotechnology in different dimensions.

INTRODUCTION

Water is a very important material to develop a country in economical, agricultural, industrial and productive fields. We should use water resources in an optimum way to improve productive and service cycles (2). Of course we should recognize all of water resources on the earth, around our environment completely and consider environmental engineering affairs. An expert team including some specialists in water engineering, environment and energy should support studies and researches (1). It is necessary to mention that waste and used materials through agricultural, industrial and home uses are dangerous for water resources; entering metals serious problems in refinement of water. On the other hand, using poisons and fertilizers in agriculture with high rate annually has reached the situation of surface waters and groundwater to a critical one. While the value of water usage in agriculture reaching to 90% - 95% of obtained water, situation type and danger are notable. So we should utilize applied and useful method to use water resources to establish ways of setting cycles in optimize an efficient state. Of course for using new sciences to water resources management, we should prepare an optimum background in this field. At first, the following stages should be done:

- Using irrigation systems
- Preventing pollution of surface and groundwater resources
- Artificial injection of groundwater resources (3)
- Localizing new water resources in our environment
- Using the best and effective techniques to artificial rain
- Using rather salty waters obtained in agricultural wastes
- Reconstructing old urban irrigation net
- Using equipment to minimize water consumption
- We should use new technologies why we are in 21st century such as new energies and nanotechnology to manage water resources and waste in an optimum behavior.

Importance of using technologies in water resources management is not an inconsiderable, and their applications have an extensive domain in many industrial fields (5). We should improve methods used to decrease pollution of water resources utilizing nanotechnology outputs. Of course we should remember that using technologies in refinement of water resources improve drinking water and helps reuse agricultural waste waters and removing drought problems to some extent. We should know that close to a half of used water in agriculture is dissipated. The point that should be mentioned is that agricultural poisons and fertilizers pollute groundwater that is a danger to water resources. Existence of some agricultural poisons in waste waters show useless compounds including nitrates dangerous directly and indirectly for drinking; why it is a cancer factor to produce potato and some other agricultural crops.

How to remove water resources pollutants?

There are some dangerous and damaging compounds and materials for waters in poisons and fertilizers (4). Water as the

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most essential item furthermore soil should be safe to be used by plants and whatever growing in lands. Using much agricultural poisons and fertilizers would be as a serious danger for agricultural usage and through industrial cycle and unhealthy water for drinking in dangerous with a false economically. In fact unhealthy water has dangerous biologically effects. Refinement of waters and taking apart waste from water by using technologies like nanotech is useful in many fields of industries and productive ones. We should use new technologies to obtain water volumes clean away from waste and pollutants. Some other works to obtain safe and healthy waters from resources are as following:

1- Developing salt removing task
2- Water resources protection
3- Reusing waste waters
4- Taking apart pollutants

Water resources management

Perhaps we should tell that water is the most necessary material for life, agriculture and many industries. Managing water resources about its consumption, conducting and optimum usage on the basis of engineering correct fundamentals should be done completely. Experts and specialists in every industrial and scientific field have some applied true concepts that if would be used, productive cycle and process is presented in a good routine without damages and dangers. Furthermore removing pollutants in water resources, water consumption, water currents conducting through canals and pipes and so protection of those resources are necessary items for water resources management. Water refinement and obtaining fresh water from salty water has some methods; in this century that developing sciences help human to live better with more welfare and to improve services in an easier way. Nanotechnology has an extensive domain through about all of scientific fields. This technology presents some methods to water refinement. One of most important applied methods to refining water (waste) by using nanotechnology is called nanofiltration as it is described detailed in the next section of this paper.

Nanofiltration

Nanofiltration (NF) is one of the four membrane technologies, which utilize pressure to effect separation of contaminants from water streams. The other three are microfiltration, ultrafiltration and reverse osmosis (RO). All of these technologies utilize semi-permeable membranes that have the ability to hold back (reject) dissolved and/or suspended solids from a water stream containing these contaminants. Each of the four technologies has its own characteristics regarding the kinds of contaminants it will remove (see Table 1). For example, NF rejects ions (dissolved ionic contaminants), but not to the same degree as RO. The ability to reject ions isn't a simple filtration mechanism, but a more complex process that's not fully understood. This mechanism depends upon the valence of the salt ion in question. Recognize that a salt is a compound of two or more ions with an electronic charge. Valence is the number of charges on the ions that form the specific salt, which is not always sodium chloride (NaCl); sodium and chloride are monovalent ions because they have only one charge, whereas ions such as calcium and sulfate are multivalent because they have more than one charge. A defining characteristic of NF membranes is that they reject multiva- lent ions to a significantly greater degree than monovalent ions. The specific rejection of ions varies from one membrane manufacturer to another, but a multivalent ion rejection of 95 percent with a monovalent ion rejection of only 20 percent isn't unusual for NF membranes. Most of these membranes available today are in spiral wound construction only, although it's expected that capillary fiber nanofilters will soon be on the market. Figure 1 illustrates NF in terms of its removal efficacy.

Table 1. Membrane technologies compare

Feature	Microfiltration	Ultrafiltration	Nanofiltration	Reverse osmosis
Polymers	Ceramics, Polypropylene, Polysulfone, Polyvinylidene fluoride, Polytetrafluoro-ethelyne, Polyacrylonitrile	Ceramics, Cellulosics, Polysulfone, Polyvinylidene fluoride	Thin film composites Cellulosics,	Thin film composites, Cellulosics, Polysulfonated, Polysulfone
Pore size range (microns)	0.1-1.0	0.001-0.01	0.0001-0.001	<0.0001
Molecular weight cutoff range (daltons)	>100,000	2,000-100,000	300-1,000	100-300
Operating pressure range (psi)	<30	20-100	50-300	225-1,000
Suspended solids removal	Yes	Yes	Yes	Yes
Dissolved organics removal	Yes	Yes	Yes	Yes
Dissolved inorganics removal	None	Yes	Yes	Yes
Microorganism removal	Protozoan cysts, algae, bacteria*	Protozoan cysts, algae, bacteria, * virus	All*	All*
Osmotic pressure effects	None	Slight	Moderate	High
Concentration capabilities	High	High	Moderate	Moderate
Permeate purity	High	High	Moderate-high	High
Energy usage	Low	Low	Low-moderate	Moderate
Membrane stability	High	High	Moderate	Moderate
Operating costs ($/1,000 gal)	0.50-1.00	0.50-1.00	0.75-1.50	1.50-5.00

Nanofiltration describes a process of water purification that removes contaminants from the water to produce clean, clear, pure water. Nanofiltration is a form of reverse osmosis, that will remove bivalvent hardness, calcium and magnesium plus sulphates but leave in most of the single valent sodium ion. Nano filtration can therefore be used as a pretreatment of seawater. Nanofiltration is used to soften seawater at low pressure (150 psi) before using seawater RO at 800 to 1000 psi to remove the sodium chloride. Nanofiltration is often chosen for hard well water and similar waters where there is copper pipe. This will soften and remove heavy metal and other organic contamination, virus and bacteria while leaving enough sodium chloride to prevent the corrosion to the copper pipes. In fact Clean Water Products provides the best equipment in the world to make your own purified water using our patented reverse osmosis technology.

Fig. 1 An advanced water filtration system

Like reverse osmosis, nanofiltration can remove bacteria, viruses, organic chemicals and pesticides. In addition, both procedures can be used to remove calcium and magnesium to soften hard water. However, there are factors that make nanofiltration a more affordable option than reverse osmosis. In the past there used to be a big difference between the pressure needed for RO as compared to nanofiltration. Nanofiltration requires a lower water pressure to operate, so energy costs associated with it are lower. While new advances in RO technology have reduced the difference significantly there is still a difference. While the difference on a home unit between reverse osmosis and nanofiltration might be negligible, nanofiltration is often preferred on a municipal level. In short, nanofiltration is an effective and adequate purification method for waters that are not exceptionally salty or saturated with dissolved solids. It is more energy effective than reverse osmosis, which is why many cities and counties choose it over reverse osmosis for wide-scale water purification. Nanofiltration, in concept and operation, is much the same as reverse osmosis. The key difference is the degree of removal of monovalent ions such as chlorides. Reverse osmosis removes the monovalent ions at 98-99% level at 200 psi. Nanofiltration membranes' removal of monovalent ions varies between 50% to 90% depending on the material and manufacture of the membrane. For this reason, there is a variety of Nanofiltration membranes available. Each type is particularly suited to a certain application and may not be acceptable to a different application. Nanofiltration membranes and systems are used for water softening, food and pharmaceutical applications. Nanofiltration is a relatively recent membrane process used most often with low total dissolved solids water such as surface water and fresh groundwater, with the purpose of softening and removal of disinfection by-product precursors such as natural organic matter and synthetic organic matter. Nanofiltration is also becoming more widely used in food processing applications such as dairy for simultaneous concentration and partial (monovalent ion) demineralisation. While nanofiltration is used for the removal of other substances from a water source, it is also commonly used for the desalination of water. As seen in a recent study in South Africa, tests were run using polymeric nanofiltration in conjunction with reverse osmosis to treat brackish groundwater. These tests produced potable water, but reverse osmosis removed a large majority of solutes. This left the water void of any essential nutrients (calcium, magnesium ions, etc.), placing the nutrient levels below that of the required World Health Organization standards. This means nutrients should be added back to bring the water back to the standards levels for drinking water. Nanofiltration methods remove fewer solutes, so may avoid the need to remineralize the water. To control water resources management and remove water criticism, we should use pre applied stage solutions such as controlling surface waters, increasing irrigation efficiency and removing water pollutants from water resources by using new technology like nanotech. In fact, 21st century with developing sciences and industries, we should find and use cheaper and easier methods to manage water resources. Innovation in subject of controlling water criticism is helpful and the key theoretically and applied. At least we could manage water resources and use water through industries and other fields in optimum behavior if this management obeys an engineering pattern under useful and rather cheap foundation take apart of damages and dangers for environment, water resources and human.

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