Application of Nuclear Technology to Water Desalinization

By Richard Bragg

Nuclear energy has incredible potential to power the future. That does not just mean the ability to meet the power needs of the world, but also a way to create cures to incurable diseases or produce desalinated water in areas where clean, drinkable water is unavailable or unsafe. Nuclear energy is capable of producing tremendous amounts of energy, while still being environmentally friendly because it does not produce any harmful greenhouse gases. It is a very reliable source as well. While other energy sources rely on weather or availability of nonrenewable resources such as coal or gas, nuclear energy can be produced without pause. In the immediate future, nuclear energy's manufacturing of clean water in areas where water is scarce is very important.

Water scarcity is a major issue in the modern world, and one that is going to worsen progressively if no action is taken. Some statistics say that only "2.82 percent of the world's water" (Nuclear WONUC) is actually freshwater, and almost "one-third of that is located in one of the world's ten largest water basins". The fact that a vast majority of the world's water is undrinkable is troubling and devastating to many areas that are arid. According to some facts presented by the World Health Organization, "almost one-fifth of the world's population lives in areas where water is scarce" (Nuclear WONUC). Millions of people die every year die from thirst or diseases that are directly related to the lack of available clean water. These are terrible statistics that are not going to change unless dramatic action is taken.

The most applicable solution is the establishment of desalination plants in these areas. This would provide potable water to those that need it for a relatively inexpensive price. For the most part the process is very energy intensive and costly. Desalination can be performed on either brackish water or salt water. There are several ways that the desalination process can be implemented, but the two most prevalent are reverse osmosis and distillation. Reverse osmosis occurs when the "water from a pressurized saline solution is separated from the dissolved salts by flowing through a water-permeable membrane" (2.1 Desalination). This happens by increasing the pressure on the water until it is forced to flow through the membrane, and then the concentration of excess original solution is removed. The majority of the energy goes into the initial pressurization of the saline solution. The required pressure differs depending on the source of water. Brackish water ranges from 250 to 400 psi, while salt water ranges from 800 to 1000 psi (2.1 Desalination). Distillation is the oldest of all the desalinization processes. It is often represented by Multiple-Effect Distillation (MED), but there are several other forms as well. The distillation process is where the salt water is changed into water vapor and then condensed into freshwater. The main difficulty is lowering the vaporization so it boils at a lower point so no additional heat is needed (2.2 Desalination). This is done by adjusting the pressure specifically to change the temperature that vaporization occurs. Although there are other forms of desalination, such as electrodialysis, these are the most commonly recognized.

Countries often have problems with producing the energy requirements of desalination plants. So a suitable energy source is needed to be able to power these plants and to help solve this problem. The best source of energy for these plants is nuclear power. According to one article "Combining the use of nuclear energy with the industrial process of supplying potable water by seawater desalination has been considered as far back as the 1960s" (Kupitz). There was some initial study, and soon there was a demonstration plant built in Kazakhstan. These plants proved to be quite successful even if they were energy intensive, the necessity of water made them an important commodity. In April 2010 "At the Global Water Summit in Paris, the prospect of desalination plants being co-located with nuclear power plants was supported by leading international water experts" (Water Industry). There are currently nuclear desalinization sites or projects in Algeria, China, Egypt, Iran, Libya, Morocco, and many other countries. According to one source "seawater desalination is merely the by-product of electrical

generation" (Nuclear WNA). Nuclear uses in desalination are an obvious choice to any country with water shortages and nuclear capabilities.

Desalination plants are very costly. They cost billions of dollars to build and the process is also very expensive. Sadly, most "desalination today uses fossils fuels" (Nuclear WNA). This means that their source of energy will eventually run out, and that these plants produce greenhouse gases. With the massive amounts of energy required for desalination, large amounts of these greenhouses gases are emitted into the atmosphere, increasing instability. Nuclear powered desalinization plants have remarkable benefits when compared to those powered by any other source. An 1100 Megawatt system costs around three billion dollars to construct which is comparable to a gas powered plant, and less than one run on coal. It also produces around 400,000 cubic meters of water daily, and produces an additional 700 Megawatts of electrical surplus. It has a production price of about 35 cents (American) per cubic meter, which is more efficient than any other source. This size system has an expected life span of about sixty years, where a coal powered plant is predicted to last for forty and other sources even less. Another great benefit from any sized nuclear desalinization plant is that it has no carbon emissions (Hodge). These factors together outmatch any other energy source that is currently available. Even medium or small nuclear reactors are suitable for nuclear energy use, though they produce less water they are still capable of producing enough to be profitable. Considering construction costs, nuclear power easily competes with both oil and gas expenditures.

When the energy cost of producing fresh water (35 cents per cubic meter), the volume of water processed(400,000 cubic meters), the expected lifespan of the system (60 years), the additional energy produced (700 MW), and the absence of carbon emissions are considered, nuclear energy is far superior to any other desalination process currently in use (Hodge). The creation of these plants will be extremely beneficial because not only does it create inexpensive drinkable water but also it produces excess electrical energy. With the energy needs of the world increasing this extra power will prove to be very useful. To this day, nuclear energy remains the most efficient and sustainable source of energy available to the world. Hopefully, nuclear energy will emerge as more than sufficient to deal with the energy needs and water shortages of the future.

Citations

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