



SEA WATER UTILISATION

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Introduction

To address the world's water scarcity, particularly in desert and coastal areas, the use of seawater is becoming more and more crucial. The potential of seawater is enormous, considering that it makes up roughly 71% of the Earth's surface. Desalination is the most common use, whereby methods such as distillation and reverse osmosis transform salty saltwater into potable fresh water, assisting areas with scarce freshwater supplies. In addition to being used for drinking, seawater is essential for industry and agriculture. While saline-resistant crops are being developed to make better use of brackish water, desalinated water is used for irrigation in agriculture. Seawater is also utilized for aquaculture, power plant cooling systems, and even the production of renewable energy sources like wave and tidal energy. Another developing topic that could provide a sustainable solution to resource shortages is mineral extraction, namely the extraction of magnesium, lithium, and other important elements from seawater.

Desalination

Desalination is the process of turning salty saltwater into fresh water that can be used for industrial, agricultural, and drinking purposes. In water-rare places, such as the Middle East, portions of Africa, and other coastal areas, where freshwater resources are scarce and under stress from misuse and climate change, this technology is essential. Thermal and membrane desalination are the two primary desalination techniques. The process of thermal desalination, which is mostly utilized in areas with abundant electricity, warms saltwater to create steam, which condenses into fresh water. Despite being energy-intensive, techniques such as vapor compression distillation (VCD), multi-stage flash

distillation (MSF), and multi-effect distillation (MED) are included in this approach. Reverse osmosis (RO), a type of membrane desalination that uses a semi-permeable membrane to filter out salts under high pressure, is becoming more popular. Compared to thermal processes, RO is typically more energy-efficient.

Despite providing a consistent supply of water, desalination has drawbacks, including high energy costs and environmental effects from brine discharge that can damage marine ecosystems. These problems are being addressed by developing energy-efficient technology and incorporating renewable energy into desalination facilities. In order to ensure water security in arid regions, nations including Australia, Israel, and Saudi Arabia have made investments in desalination.

Cooling in Industrial Processes

In sectors including power generation, petrochemicals, and refineries, seawater cooling is a productive and economical way to control heat produced by equipment and operations. This technique makes use of the plentiful supply of seawater, which is particularly advantageous in coastal regions or areas where freshwater is limited and only used for home and agricultural purposes. Seawater is extracted from the ocean, circulated through heat exchangers to absorb heat, and then released back into the ocean as part of the system's usual open-loop operation. This method is a cost-effective option for businesses in arid areas since it does not require freshwater cooling towers.

Seawater cooling has benefits, but it also has drawbacks for the environment, like thermal pollution. By increasing the local water temperature, warm seawater discharge can disrupt marine ecosystems and endanger aquatic

life. Facilities frequently utilize cooling ponds or diffusers to reduce the discharge temperature in order to address this. Furthermore, the high salt concentration of seawater speeds up equipment deterioration, making corrosion-resistant materials like titanium or stainless steel necessary for long-term use. Seawater cooling is a dependable and essential cooling solution for many industrial activities, despite ongoing issues. Technological developments have also helped lessen environmental concerns.

Aquaculture

Mariculture, often known as seawater-based aquaculture, is now crucial to supplying the world's seafood demand, generating employment, and promoting food security. This practice, which is frequently concentrated in places like Southeast Asia, China, and Europe, entails raising fish, mollusks, crustaceans, and seaweed in maritime habitats. For the advantage of species including shrimp, oysters, seaweed, salmon, and sea bass, as well as to encourage better growth, seawater allows aquaculture operations to closely mimic natural ecosystems. To provide a clean, oxygen-rich atmosphere, a variety of techniques are employed, such as open ocean cages and onshore tanks that receive seawater via pumping.

In particular, seaweed farming is very sustainable because it doesn't need feed, fertilizer, or freshwater. Seaweed farms provide habitats for other marine animals and aid in pollution reduction by absorbing surplus nutrients from saltwater. Nonetheless, there are still issues, such as the effects of extensive marine farming on the ecology. Fish farm waste and pesticides can deteriorate water quality, resulting in areas with reduced oxygen levels. By utilizing waste from one species as nutrients for another, sustainable practices like integrated multi-trophic aquaculture (IMTA), which mixes species like fish, shellfish, and seaweed, aid in maintaining ecosystem balance.

Dense populations on farms also make disease management difficult since they can cause outbreaks that impact both farmed and wild populations. Technological developments are making seawater-based aquaculture more

sustainable in spite of these problems, and there is a lot of room for growth.

Salt production from seawater

Solar salt production, also known as salt manufacturing from seawater, is an age-old, sustainable process that uses wind and sun energy to drive natural evaporation. Shallow ponds, sometimes known as salt pans, are used in coastal areas with hot, dry climates, such as the Mediterranean, India, and portions of the United States, to slowly evaporate seawater. As water evaporates, the salt content is concentrated as seawater passes through a sequence of tiers of ponds. It is possible to extract salt crystals from the pond beds if the brine has reached a sufficiently enough salinity.

Relying on wind and sunlight, this environmentally benign technology uses little mechanical energy and avoids the high energy expenses of mining or chemical treatments, which are utilized in conventional salt production methods. The resultant sea salt has trace minerals including potassium, calcium, and magnesium that are useful in cooking and for health.

This environmentally beneficial technology avoids the significant energy expenditures involved with mining or chemical treatments used in conventional salt production processes, and it uses little mechanical energy, depending instead on wind and sunlight. Beneficial trace minerals including potassium, calcium, and magnesium are present in the resultant sea salt and are useful in both culinary and medicinal uses. Although the environmental impact of solar salt production is minimal, salt ponds must be carefully managed to preserve coastal habitats. In order to reconcile economic expansion with environmental preservation and ensure the long-term viability of this ancient approach, sustainable practices and advances in solar salt production are crucial given the expanding global need for salt.

Conclusion

The utilization of seawater offers sustainable solutions to address global needs in water, energy, industry, food, and mineral

resources. Desalination has become essential for fresh water in arid and water-stressed regions, providing a reliable supply for drinking and agriculture as new technologies improve its efficiency and environmental impact. Seawater cooling systems help regulate industrial processes, especially in coastal areas, reducing freshwater demand while requiring careful management to minimize ecological disruption. In food production, seawater-based aquaculture supports seafood supply, economic growth, and environmental balance through practices like integrated multi-trophic aquaculture (IMTA). Additionally, solar salt production is an eco-friendly method that relies on natural evaporation, producing mineral-rich sea salt for various applications while preserving coastal ecosystems. As global demand for water, food, and resources grows, seawater offers a valuable resource. However, responsible management and technological innovation are crucial to ensure sustainable use that balances economic development with environmental conservation.