

New technology and developments to prevent freshwater evaporation and increase the water content of lakes and dams

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Evaporation flow

It is one of the main components in the water cycle that must be considered in water resources planning. The reduction in lake water due to high evaporation negatively impacts natural habitats, drinking water sources, and agriculture. In areas with high evaporation, measures such as runoff management, dam construction, and vegetation around lakes can help conserve water resources.



Figure 1- Evaporation of water on the surface of lakes

The rate of evaporation of freshwater lakes depends on several factors such as air temperature, humidity, solar radiation, wind speed, and water depth. The more favorable these factors are, the greater the rate of evaporation, so that in hot and dry regions, lakes lose their water more rapidly. New studies warn that the Earth's freshwater reserves are rapidly depleting, with more than 40% of the European Union's population already facing water shortages due to global warming.

Led by ASU researchers, a new study of two decades' worth of satellite data has identified four "mega-drying" regions in the Northern Hemisphere, with freshwater lost to extreme heat, extended droughts, and significant draws on groundwater supplies.

According to the Joint Research Centre (JRC), by 2050 up to 65 million people in the EU and the U.K. could experience water scarcity for parts of the year if greenhouse gas emissions keep increasing. The JRC also estimates that the economic damage from drought alone could amount to €12-15 billion by 2050 and up to €45 billion by 2100. Meanwhile, destruction from coastal and river floods will cost up to €287 billion annually by the end of the century.

three-quarters of the global population lives in the 101 countries identified in the study as suffering from 20 years of profound freshwater loss, according to the release, with the potential for devastating impacts to ecosystems, agriculture, human health, and social stability.

The amount of water lost due to evaporation from lakes and dams in European countries is estimated at 50% and more than 50% in the Middle East. Statistics show that about 70% of rainfall evaporates in Iran.

In Iran, the total annual net agricultural water consumption is estimated to be about 43 billion cubic meters, of which about 98% is for domestic use. If all possible land were used for agriculture, about 77 billion cubic meters of water would be needed. Using satellite imagery, it has been calculated that total evaporation from agricultural land is estimated at about 55 billion cubic meters for 2020.

It takes approximately 540,000 calories, or 2,256 kilojoules of energy, to evaporate one liter (1 kilogram) of water. This amount of heat is absorbed from the surrounding environment, turning the evaporation process into an endothermic (cold) process.

Measures and solutions to prevent freshwater evaporation

Simple measures – like taking shorter showers and not leaving the tap running unnecessarily – can really help. Using drip irrigation can reduce freshwater use by up to 50%.

-Using physical methods to reduce evaporation includes:

- 1- Continuous or modular floating coating as: Floating continuous covers, Floating modular covers
- 2- Suspended coatings as Shade cloth, the cover of solar photovoltaics PV, injection of air bubbles into water or bubble plume, installing solar panels on dam reservoirs

-Using chemical methods such as: Hexadecanol and octadecanol combinations, WaterSavr

-Using biological coatings as: floating plants, Wind breakers

Wind is one of the most important factors that affect the rate of evaporation from water surfaces. Planting of trees normal to the direction of windward is an effective method for reducing of evaporation losses.

Physical methods of evaporation reduction can save a large percentage of water (between 70 and 95%), their capital costs are high, but their maintenance costs are not expensive. Installing solar panels on rivers can have disadvantages such as: high initial cost for installation, lack of energy and sunlight reaching the water molecules, lack of water disinfection, formation of algae and some pathogenic bacteria in the water, etc.

Chemical methods of evaporation reduction save a small percentage of water (between 20-40%), their capital costs are not large, but their maintenance costs are significant.

The method of injecting air bubbles into water can be the most effective method of reducing evaporation for deep waters (more than 18 meters).

The use of biological covers (despite transpiration and high water consumption for plants) can significantly reduce the volume of evaporation.

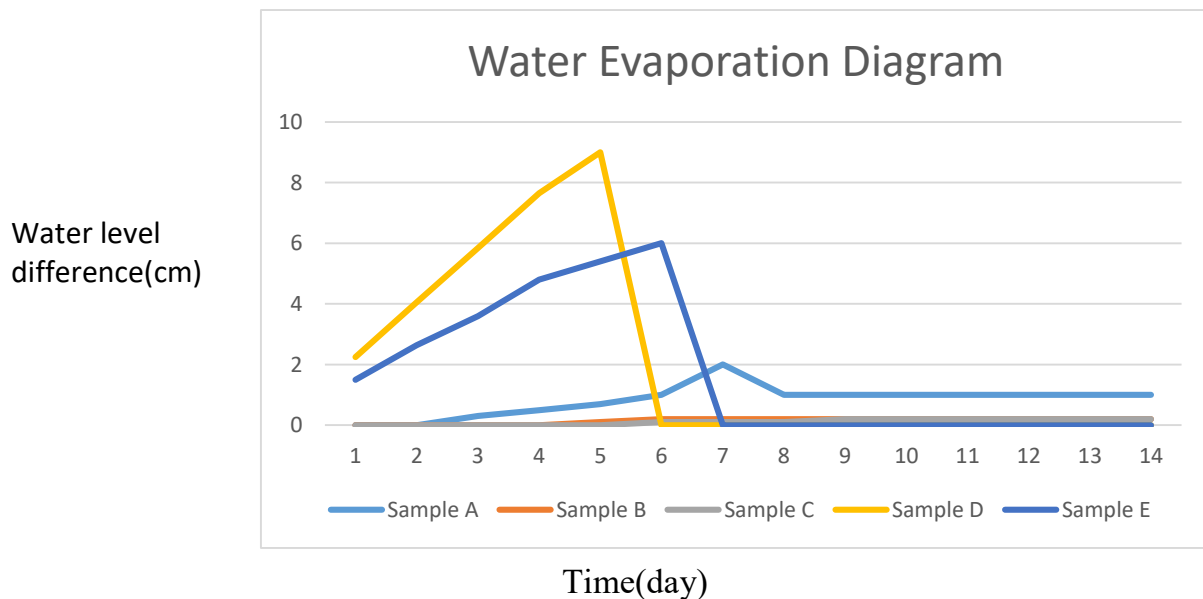


Figure 2-Water Evaporation Diagram

Water level difference(cm)						
Temp	Sample A	Sample B	Sample C	Sample D	Sample E	Time(day)
46	0	0	0	2/25	1/5	1
48	0	0	0	4/05	2/64	2
48	0/3	0	0	5/85	3/6	3
49	0/5	0	0	7/65	4/8	4
47	0/7	0/1	0	9	5/4	5
47	1	0/2	0/1	0	6	6
48	2	0/2	0/1	0	0	7
47	2	0/2	0/1	0	0	8
48	2	0/2	0/2	0	0	9
48	2	0/2	0/2	0	0	10
47	2	0/2	0/2	0	0	11
46	2	0/2	0/2	0	0	12
47	2	0/2	0/2	0	0	13
48	2	0/2	0/2	0	0	14

Table 1- temperature, time and water level difference

Samples D and E are pure water and the one-day difference in water evaporation is due to the difference in the depth of the containers. (Container D is about 3 cm deeper) Also, the difference in evaporation in sample A compared to samples B and C is due to the amount of materials used. In sample A, fewer materials were used.

Our proposed method was a chemical one, and by adding some substances to the water, the evaporation rate was reduced to 2% or less (0%). In this method, a very high percentage of fresh water (98% -100%) was saved, which is a great success. The maximum air temperature during the test is 48 degrees Celsius, the relative humidity is 8%, and the test duration is two weeks. It also has a very low initial cost and maintenance of materials and is cost-effective. Our proposed method is very different from other previous chemical methods in terms of maintenance costs, water storage, and evaporation.