Notes on the environmental impact of desalination

The study "The state of desalination and brine production: A global outlook" was recently published in the journal **Science of the Total Environment**, and had a great impact on Spanish and international media. The study was written by scientists from the Institute for Water, the Environment and Health from the United Nations University (UNU-INWEH), Wageningen University (Holland), and the Gwangju Institute of Science and Technology (South Korea).

First of all, **the Spanish Association of Desalination and Reuse (AEDyR) considers that desalination and reuse of water play a key role to solve the problems of water-scarcity suffered by many countries and regions in the world today** and will do so in the future. In this sense, the R + D + i, as well as the scientific and academic analysis of all the aspects related to the desalination and reuse of water have been, are and will be key to advance and implement technological improvements in this sector. Therefore, AEDyR actively encourage, to the extent of our resources, this aspect.

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After a follow-up of the publications that have been released about this study in the media, and with the aim of avoiding social alarm about the environmental impact of the sea-water desalination, we consider it is important to present some facts and considerations:

- **All desalination technologies separate the intake water (seawater or brackish) in two different streams:** a freshwater stream (desalinated water) and a stream of brine (also called concentrate). The source of the brine is the intake water, but with a greater concentration of salts. This is because the salts are diluted in less amount of water. The salinity of the brine stream depends on the concentration of salts in the intake water.

- **The percentage of desalinated water and brine is different in each desalination plant**. It depends on the water recovery ratio, which is related to the processing efficiency of each desalination plant.

- The different desalination technologies are associated with different water recovery ratios. The membrane processes (Reverse Osmosis, Nanofiltration and Electrodialysis) are associated with much higher recovery ratios than thermal processes (MSF, MES). Reverse Osmosis is today the most used technology both in Spain and internationally.

- The quality of the feedwater is also an important factor to determine the recovery ratios of a plant. Recovery ratios increase when salinity of the intake water decreases, and consequently decrease when salinity is higher. It is technically more complex and expensive to operate with a high recovery ratio when the intake water has higher salinity.

- **The design of each desalination plant is unique**. There are no two identical plants, since it is necessary to adapt their design to the specific local conditions. This is also the case with the brine discharge. It is designed to minimize the impact of each plant given the specific local conditions.

- The brine discharge systems are designed through the construction of outfall pipelines with diffusers and pre-dilution, **which facilitate that the brine dilutes quickly once in contact with the sea and the marine currents.**

- All desalination plants are subject to periodic feasibility and environmental impact studies approved by a competent authority. These studies analyse the possible impact of the brine in depth.

- There are numerous Spanish and international studies **that confirm the harmlessness of the brine in the marine environment** when the discharges are carried out correctly.

- **Spain has been leading the way when it comes to environmental protection in relation to brine discharge**. Many research projects from Cedex and different universities has resulted in recommendations for environmental monitoring of desalination plants. These recommendations have later been adopted by other countries.

- Various projects in Spain and the rest of the world are constantly researching improvements in the efficiency of desalination techniques. New brine treatment techniques are currently being developed. **It is feasible to think that there will be new developments in these areas in the next few years**.

- According to data given by the study, and taking into account the desalinated water produced and the brine rejected by geographic areas, we see that the recovery ratio generally is approximately 0.50. According to the study this occurs in all geographical areas except for the Middle East, which is the region were the highest percentage of global brine (70.3%) is produced.

- Without entering into assessments on these figures, it is important to consider that this geographical area is also where the greatest amount of large thermal desalination plants are concentrated. As explained earlier, thermal processes have lower recovery ratios than Reverse Osmosis, and consequently has higher brine streams. The plants in this region mainly use MSF technology. There has not been constructed new plants using MSF in Spain since the 90s.

- It should also be noted that in recent years **Reverse Osmosis has been the most applied technology** in the construction of new plants in the Middle East region. It is expected that this trend will continue over time towards indices more in line with the global ones.

- And last but not least, even if these local imbalances may cause concern, **it must be clear that the overall saline balance of the sea is constant**. After its use, the desalinated water (as the rest of the water resources) is treated again in wastewater treatment plants and returns to the sea through the rivers.
  Minimizing the environmental impact has been one of the highest priorities of the Spanish desalination industry throughout its history. To know more about this, we invite you to watch the documentary produced by AEDyR "History of desalination in Spain", in which one chapter analyses the environmental sensitivity of desalination in Spain.