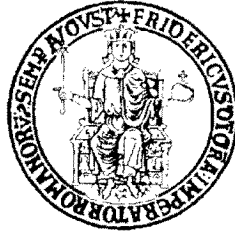


UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II



DEPARTMENT OF ENGINEERING

Corso di Laurea in Ingegneria per l'Ambiente e il Territorio

Classe delle Lauree Specialistiche in Ingegneria per l'ambiente e il territorio

N.38/S

Final Dissertation

Abstract

DESALINATION AND IRON SCALE ISSUE

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Academic Year 2008/2009

INTRODUCTION

Desalinated water is expected to become an increasingly important source of drinking water in many places in the near future, and its global capacity is growing at a rate of 25% per year. Interest in desalination has developed rapidly in order to ease the primary problem of the lack of adequate water supply during periods of drought. It has been technically possible to take the water and leave the salt since long time ago and nowadays the most common technology used is reverse osmosis (RO), and it accounts for more than 46% of desalinated water plants worldwide and more than 60% in USA. The membranes used in RO allow the passage of water molecules while barring the passage of salt or other contaminant molecules.

Compared with conventional surface and ground water treatments, reverse osmosis desalination produces water with much lower concentrations of natural organic matter (NOM) and all inorganic ions, except for chloride, bromide and boron, due to their abundance in seawater. Desalinated water is also usually low in pH, alkalinity and potentially corrosive. When it is blended with conventionally treated surface water or groundwater and enters a drinking water distribution system (DWDS), pronounced differences between the chemistries of these water types can affect many processes in DWDS, including corrosion of metals. Specifically, iron corrosion in DWDS is a big concern because of the large amount of iron pipe that is in use. If the iron scales that have been formed are destabilized after the introduction of desalinated water, iron particles can be released and give drinking water a red, brown, or yellow color, or a dirty appearance. The stability and speciation of these iron solids depends on the water chemistry in which they have been formed. They are also labile towards changes of water chemistry after desalinated water is blended at different ratios with the existing water source.

Of all the important water quality parameters that are known to affect the corrosion of metals in potable water, including pH, alkalinity, other organics and inorganic ions

and oxidants, the influence of NOM is the least understood. Because both the concentration and properties of NOM are likely to be altered by water treatment processes common in the water treatment industry, several issues relevant to further progress in elucidation of the role of NOM in corrosion processes need to be answered. These questions include the evaluation of specific effects of NOM on the corrosion of the major types of iron-corrosion and the relationship between the NOM concentration and the rate of corrosion and iron release.

So it's important to discover how the stability of iron scale will be changed if a different type of water, such as desalinated water, flows in the distribution system. Moreover, existing toxic elements, which previously were adsorbed on iron scale, in this new picture, may be released with iron and become a serious environmental issue.

Desalinated water used in the experiments was produced by the Seawater Desalination Pilot Plant in Santa Cruz, California. The Santa Cruz Desalination Plant is currently a pilot plant which began in March 2008 and was completed in April 2009. The treated surface water was produced by Graham Hill water treatment plant (the main drinking water plant in the city of Santa Cruz). This study wants to look specifically at the city of Santa Cruz because it will try to use desalinated water as a new drinking water source, in addition to surface water, so experiments done want to examine the impact of this water change on iron release¹. Iron scales used in this study were harvested from the Santa Cruz drinking water distribution system too.

The main objectives of the study are:

- To verify effects of iron scale in different type of water.
- To quantify iron release in surface water and its blends with deionized and desalinated water (from Santa Cruz).

- To examine the effect of pH and background NOM concentration on iron and DOC release from iron scale.
- To quantify other elements (Mn,Mg,Al,Cu,Pb,Ca,As,Si) release in water blends.
- To understand which type of NOM is released from iron scale, and which type of NOM pre-exists in Graham Hill water.

Even if information concerning the influence of NOM on lead and copper corrosion and release may be found in several publications the relationship between iron release and NOM has not been analyzed in the literature, so there is a need for more detailed studies focused on the behavior of iron scale in drinking water.

CONCLUSIONS

Based on the experimental data, the following conclusions can be drawn:

- More iron is released when the background DOC concentration is higher. The experiments show higher concentration of soluble iron in GH water, between 100-140 $\mu\text{g/L}$, while for 100% DI water it changes between 20-50 $\mu\text{g/L}$.
- Moreover in absence of desalination water there is more dissolved organic carbon than other blends and it may be caused by natural organic matter (NOM) present in these Graham hill water and absent in desalinated water. Prior research shows that the presence of even low concentrations of NOM is associated with the mobilization and dispersion of corrosion scales formed on corroding metal surfaces, NOM cause surface complexation on iron particle surfaces and increase iron colloidal mobilization (e.g., Korshin, G.V., J.F.Ferguson, S.A.L.Perry(1996)).The results lead to the conclusion that DOC release from iron scale is a fast process. The concentration of DOC in iron scale suspension remains the same level about 12 hours after iron scale is added into the blends. Even Graham Hill water has got the highest

concentration of DOC, more amount of DOC is released from iron scale when the background DOC concentration in the solution is lower. This is suggested by the different DOC released between 100% DI water and 100% Graham Hill water.

- pH has moderate impact on DOC release from iron scale. Higher pH increased DOC release from iron scale when DOC concentration is low in the solution.
- Calcium Chloride is added into the samples and UV and Fluorescence measurements show lower values than blank samples, so it probably implicates that Calcium Chloride is an inhibitor concerning iron release. Finally the digestion of HClO₄ in deionized water with iron scale shows that the type of NOM released from it is not Amino-acids.

