



## Colloidal iron and manganese in water affecting RO operation

Robert Y. Ning

*King Lee Technologies, 8949 Kenamar Drive, Bldg. 107, San Diego, CA, 92121, USA  
Tel.+1 (858) 693-4062; Fax +1 (858) 693-4917; email: Rning@kingleetechnology.com*

Received 14 November 2008; Accepted 22 September 2009

---

### ABSTRACT

The finding of various forms of iron, and less commonly of manganese, in numerous reverse osmosis (RO) membrane autopsies we have performed, have led us to call attention to the diverse forms of iron and manganese species in natural waters. Correlation of elemental composition analyses of foulants with contaminants in RO feedwater and pretreatment steps led to successful solutions of fouling problems by the modification of pretreatments, such as substitution of oxidation filtration strategies for iron and manganese reduction with sequestration with appropriate antiscalants. Cases where iron and manganese fouling failed to respond to sequestration with antiscalants, the existence in the RO feedwater of pre-existing colloidal iron and manganese particles are suspected. To fully control such fouling, speciation of the different forms of iron and manganese that exist in natural, industrial and wastewaters are central to process design, troubleshooting and RO system operation and maintenance. We have undertaken a literature review of iron and manganese colloidal chemistry as it pertains to the RO membrane process. This paper reviews the background for the association of iron with manganese in water treatment, natural sources of colloidal iron and manganese, early works on methods for the reduction of iron and manganese in traditional municipal waterworks where colloidal particles may be formed and not removed, speciation of forms of iron and manganese in water treatment, and the effects of colloidal iron and manganese on RO operation. The overall conclusion is that methods for the speciation and quantitation of colloidal forms of iron and manganese need to be fully developed and employed for the validation of methods useful for the control and/or removal of such foulants in RO feedwaters.

*Keywords:* Colloidal iron; Colloidal manganese; Speciation; Quantitation; Reverse osmosis; Membrane fouling; Natural sources; Introduction in pretreatment

---