This research investigated the use of seawater regeneration for anion exchange (AIX) processes. Seawater and salt-supplemented seawater regeneration of chloride-form anion resin were evaluated in regard to (1) operational performance efficiency of sulfate and natural organic matter removal, (2) competing exchange of bromide during regeneration, and (3) brominated disinfection by-product (DBP) formation due to bromide leakage. The first component involved bench-scale research that revealed that seawater-based regeneration led to bromide leakage that could be mitigated to an average of 1.82 mg/L using 1% salt-supplemented seawater, and 1.25 mg/L using 3% salt-supplemented seawater. Conceptual cost comparisons revealed that the use of seawater can reduce regeneration costs by up to $0.25/kgal compared to conventional 10% salt. The second segment of research demonstrated that bromide adsorption in the presence of chloride followed pseudo 2nd order kinetics. Increasing the chloride-to-bromide ratio shifted intra-particle diffusion that revealed an exponential decay in bromide adsorption capacity. The equilibrium adsorption behavior could be described by both Freundlich and Langmuir isotherm models. The third segment of research evaluated the impacts of bromide leakage with respect to DBP formation. Results demonstrated that the 96-hr formation potential for total trihalomethanes (TTHMs) increased from 186 µg/L to 294 µg/L and haloacetic acids (HAA5) from 25.7 µg/L to 36.1 µg/L for a subsequent increase in bromide content from 0.22 mg/L to 2.13 mg/L, respectively, with a noticeable shift in chemical speciation from chlorinated to brominated forms. Coastal water utilities employing AIX might consider salt-supplemented seawater regeneration methods; however, further research is needed to confirm the long-term performance effects of this technique.