Application of membranes to treat wastewater for its recycling and reuse: new considerations to reduce fouling and increase recovery up to 99 percent

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Received 7 November 2010; Accepted 18 May 2011

ABSTRACT

The RO process is very attractive for providing high product quality through the removal of a number of contaminants like oil, detergents, organics, nitrates, ammonia, phosphates etc. However the main disadvantages of the modern RO techniques are connected with membrane fouling, concentrate flow and pretreatment that increase operational costs, complicate design and create problems of brine utilization. Often pretreatment costs even exceed reverse osmosis facilities costs. Now a number of successful attempts were undertaken to modify spiral wound membrane channels to limit fouling and scaling potential. As presented in a number of publications, elimination of the spacer mesh from the feed channels eliminates dead regions that provide scaling and fouling conditions whilst also reducing the risk of particle “trapping” and associated dramatic pressure increase. Introduction of a new “open channel” configuration offers a new perspectives to escape fouling and development of novel techniques to treat water with high fouling potential (high suspended matter, organics and supersaturated solutions). This novel concept of spiral wound module with an “open channel” design is developed, field-tested and introduced into practice. Fouling control is achieved due to the elimination of spacer and the implementation of an optimum hydraulic mode providing sufficient cross flow velocities, flushings and cleanings. The main principles of high recoveries, low maintenance and zero discharge are ensured by concentration of brine through re-circulation by 50–100 times by volume. Several examples of water treatment flow diagrams are presented to demonstrate of zero concentrate flow discharge. Coagulated suspended matter after membrane flushes is collected, sedimented and finally dewatered. The concentrated solution containing salts and impurities together with the wet sludge constitutes no more than 1 percent of initial water in part due to high supersaturation values due to the strong stability of calcium carbonate solutions.

Keywords: Nanofiltration; Open-channel module; Scaling; Spiral wound module

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