

Energy recovery through a water-hydraulic motor in a small-scale RO desalination system

Yu Chang Kim^a, Young-Bog Ham^b, Sang-Jin Park^{a*}

^aDepartment of Energy Plant, ^bDepartment of Energy Systems, Korea Institute of Machinery and Materials (KIMM), 104 Sinseongno, Yuseong-gu, Daejeon, 305-343, Korea
Tel. +82 (42) 868-7360; Fax +82 (42) 868-7051; email: giant@kimm.re.kr

Received 12 November 2009; Accepted in revised form 24 December 2009

ABSTRACT

The use of energy recovery devices (ERDs) is now well known in seawater desalination. These devices are classified into two kinds of ERDs — one is the centrifugal turbine type and the other is the positive displacement type. However, because these ERDs are appropriate for large-scale reverse osmosis (RO) systems, a different type of ERD suitable for small-scale RO systems is required. For energy recovery in small desalination plants, hydraulic pump-hydraulic motor assembly is preferred due to the benefits including high efficiency, low pulsation, and no maintenance. For this reason, we are developing an integrated pump combined with energy recovery function. That is, the pump and motor pistons are contained in one cylinder barrel so that this integration can provide compact design. In this work, we present the experimental results of the small reverse osmosis system equipped with a water-hydraulic motor of axial piston type based on the swashplate principle for feasibility test about the mechanism of ERD-integrated pump under development. This motor converts hydraulic energy (brine pressure) to mechanical energy (torque) and reduces the energy used by the electric motor driving the axial piston pump. By using the water-hydraulic motor, the energy consumed by pump was recovered by approximately 60%. In addition, the power consumption of the pump and the power production of the motor were compared at the different motor speeds and feed temperatures. As a consequence, it is expected that the ERD-integrated pump based on the mechanism of the hydraulic pump-motor assembly will be a suitable alternative to ERD in a small-sized RO desalination system in the future.

Keywords: Energy recovery; Reverse osmosis; Desalination; Axial piston pump; Water hydraulic motor

* Corresponding author.