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Dear Mrs. Reham Gharbiyeh,
Chief Executive Officer,
Al Urdonia Lil Ebda.

As requested by the technical committee during the projects evaluation for admission to North Innovation Centre. Mr. Muhsen Abu-Haifa, project entitled "Wasted water saving from RO systems" was tested. Mr. Abu-Haifa modified the RO system at the Chemical Engineering Department at JUST, and another RO system was modified at house in Irbid (House of Eng. Moath Al-Ma'agbeh-0797517544) as requested by us at the university, for comparison.

The two modified systems were tested in regard to water savings and the quality of reject water that will be used for domestic household use. The results are presented in this report. Engineer Ma'amoon Khudair from JUST tested the both modified systems and collected the data under the supervision of Prof. Munther Hadad the head of the Chemical Engineering Department at JUST.

Based on the results; the project are of significant important to Jordan as well as it is very beneficial to the average house using RO water filtration system in cutting the water bill. Projects like this one needs to be supported and encouraged.

Kindly see the attached report, for further inquires do not hesitate to contact me, and looking forward to work with you in the future.

Dr. Tarek Al-Qasim

 03/07/2011

Deanship of Scientific Research, Assistant Dean
Technology Transfer Office, TT Officer
Faculty of Engineering, Ind. Eng. Dept, A. Professor

Phone: +962 (2) 7201000 Ext: 22735

Fax : +962 (2) 7201073

Email : tqqasim@just.edu.jo

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Water Saving Calculation

Sample calculation based on single membrane presented here (based on the results, the single membrane reject 50% of water in comparison with the double membrane. i.e. for each litter of filtered water used the single membrane reject 4 litters and the double membrane reject 9 litters), the lower value of reject water for single membrane RO system were taken to estimate the total water savings as a conservative estimate.

The average filtered water needed per person per day = 5 litters, for average family consists of 5 persons. Total fresh water usage per family per day is approximately 25 litters.

Based on this, the total filtered water used per family per year is = $25 \times 365 = 9125$ liters.

Water reject (for single membrane) per family per year = $9125 \times 4 = 36500$ liters.

It is estimated that 500,000 RO water treatment units are installed in Jordan

Total water reject from these units are = $500000 \times 36500 = 18250000000$ liters = 18250000 m^3

18.2 million cubic meter of fresh water is wasted down the drain every year in Jordan.

Repeating these calculations for double membrane RO system this number comes up to **41 million** cubic meter of fresh water is wasted down the drain every year.

It is important to note that:

- Two systems were evaluated and tested, one at the university laboratory and one at domestic house in Irbid. The system tested at the university in two configurations single membrane and double membrane RO systems.
- These calculations for household use only and did not take into account the industrial applications, offices and hospitals etc. If we take these premises into account the above number could be doubled or trebled.

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- The TDS (salt concentration) of the reject water is within acceptable limit and can be used safely for domestic household use. Note that the US standards for TDS is 500 ppm; The allowable limit in Jordanian standards for TDS is 500 mg/l and 1500 mg/l (ppm) in case no better resource is available [Ref. attached].
- The data provided shows that after mixing the reject water with tap water the TDS fall very significantly from 520 to 390 ppm. In addition, a control valve was added/installed to the system (as suggested by the Head of Engineering Chemistry Department) to control this mixture and reduce the TDS value further more if needed.
- The tested system can be incorporated to the existing systems already installed at homes.
- All new system can be developed, which will be compact and competitive to the existing imported systems sold in the market.

Conclusion

In conclusion, the results show a significant water savings using conservative estimate in the calculations. This water saving is very important to our country with limited water resources. Furthermore, the saved water is safe to be used as shown in the TDS values. The potential of improvements and commercialize the system is huge; this can be seen from the interest of faculty members at JUST in such system.

I recommend strongly to support this project and to continue monitoring the progress of the applicant, to develop and improve the system further, I/ the university will give him all the technical support he need.

Dr. Tarek Al-Qasim

