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Corrigendum

Mineral extraction from seawater reverse osmosis brine of Gulf seawater

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In the original version of the article "Mineral extraction from seawater reverse osmosis brine of Gulf seawater" published in vol. 144 (2019) pp. 45–56 (doi:10.5004/dwt.2019.23679) the following corrections are made:

1. **Page 45, Abstract**

   At the end of the Abstract the following text appears:
   "The preliminary economic evaluation of magnesium oxide production using RO brine of desalination plants at Doha Desalination Research Plant and Shuwaikh sites of Kuwait are 228 and 97,909 tons per year, respectively".

   This should read:
   "The preliminary economic evaluation of magnesium oxide production using RO brine of desalination plants at Doha Desalination Research Plant and Shuwaikh sites of Kuwait are 699.39 and 177,527.82 tons per year, respectively."

2. **Page 47, 2.1. Sampling and physicochemical parameters determination**

   The fourth sentence reads:
   "The total recovery of DRP RO plant is ≈40% whereas; of Shuwaikh SWRO plant is ≈50%–60%."

   This should read:
   " The total recovery of DRP RO plant is ≈30%, whereas of Shuwaikh SWRO plant is ≈50%."

3. **Pages 53–55. 3.4. Preliminary economic evaluation of magnesium oxide production using SWRO brines**

   Section 3.4. should read:

The laboratory scale mineral precipitation experiments showed that magnesium was precipitated in more quantity from SWRO brines. The SWRO brine of Kuwait contains higher concentration of magnesium compared to other minerals and the by-product of magnesium (MgO, $MgCl_2$, etc.) are widely used in constructions and chemical industries and have high commercial values. Therefore, the preliminary economic evaluation of magnesium oxide production using Kuwait SWRO brines was performed.

DRP SWRO plant capacity is about 300 m^3/d production and total dissolved solid in brine is approximately 54,900 ppm. The amount of magnesium present in DRP SWRO brine is 1,673 mg/L. The recovery ratio is about 30% and quantity of the rejected brine is approximately 700 m^3/d. From the above data, it was calculated that 1,171.1 kg of magnesium is present in DRP SWRO brine per day.

Accordingly, the amount of magnesium present in the rejected brine from DRP SWRO plant calculated is approxi-

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mately 427.45 ton/y. Based on the results obtained in this study and assuming that 98% of magnesium can be precipitated using NaOH as base at 90°C and pH 10, then the amount of magnesium that can be produced per year is ≈ 421.83 ton/y.

The molar mass of Mg is 24.3050 g/mol, whereas, molar mass of MgO is 40.3044 g/mol. So, theoretically, one gram of magnesium can produce 1.658 g of magnesium oxide. Accordingly, the total amount of magnesium oxide (MgO) that can be produced per year from DRP SWRO brine is 699.39 ton/y. Considering the market price of MgO at 3,500 USD per ton, the annual benefit that can be achieved by extracting MgO from DRP SWRO brine is 2,447,865 USD per year. The chemicals used were NaOH and hydrochloric acid (HCl). The NaOH was used to increase the pH to 10 in the precipitation stage, whereas, HCl was used to reduce the pH to 7 in the post treatment stage. The required quantity of NaOH and 0.1 N HCl is 6.0 and 8.0 g/L, respectively. The market price of commercial grade NaOH is USD 300 and HCl is USD 90. Accordingly, the total cost of chemicals required for precipitation and post treatment is 460,083.33 USD/y.

Shuwaikh SWRO plant capacity is about 136,000 m^3/d (36 million US gallons a day) and total dissolved solid in brine is approximately 78,000 ppm. The amount of magnesium present in Shuwaikh SWRO brine is 2,703 mg/L. The recovery ratio is about 50% and quantity of the rejected brine is approximately 136,000 m^3/d. From the above data, it was calculated that 367,608 kg of magnesium is present in Shuwaikh SWRO brine per day.

Accordingly, the calculated amount of magnesium present in the rejected brine from Shuwaikh SWRO plant is approximately 134,176.92 ton/y. Based on the results obtained in this study and assuming that 78% of magnesium can be precipitated using NaOH as base at 90°C and pH 10, then the amount of magnesium that can be produced per year is ≈ 107,073.48 ton/y. The total amount of magnesium oxide (MgO) that can be produced per year from Shuwaikh SWRO brine is 177,527.82 ton/y. Considering the market price of MgO at 3,500 USD per ton, the annual benefit that can be achieved by extracting MgO from Shuwaikh SWRO brine is 621,347,370 USD per year. The required quantity of NaOH is 10.5 g/L and 0.1 N HCl is 16.0 g/L. The total cost of chemicals required for precipitation and post treatment at Shuwaikh SWRO is 152,637,480 USD/year.

The TDS of feed (SWRO brine), filtrate after extraction and post-treated (neutralized) are almost same and contains less concentration of divalent ions as shown in the table 6. The neutralized reject after mineral extraction can be used for further water extraction using; thermal desalination process by increasing the top brine temperature; high pressure RO; forward osmosis (FO) and membrane distillation (MD) [58, 59].

4. Page 55. Conclusion

At the end of Conclusion the following text appears:
" The preliminary calculation showed that approximately 228 and 97,909 ton/year of magnesium oxide can be produced from DRP and Shuwaikh SWRO brine, respectively. Accordingly, the annual benefit from the produced magnesium oxide is 572,010 and 244,772,500 USD/year from DRP and Shuwaikh SWRO brine, respectively."

This should read:
" The preliminary calculation showed that approximately 699.39 and 177,527.82 ton/year of magnesium oxide can be produced from DRP and Shuwaikh SWRO brine, respectively. Accordingly, the annual benefit from the produced magnesium oxide is 2,447,865 and 621,347,370 USD per year from DRP and Shuwaikh SWRO brine, respectively."

The authors would like to apologize for any inconvenience or misunderstanding.