

## NaCl Dissolution Rate to Form Brine Solution

6/20/03

### INTRODUCTION

Problem-Difference in the rate of dissolution of 97% pure NaCl in water to form Brine solution.

Possible cause of problem- size difference in the particles of NaCl.

### EXPERIMENT

Procedure- Using a pump, circulate water at a rate of **85ml/minute** to dissolve a **23/77 ratio of NaCl to water**, by weight. Record the temperature of the mixture. Record the time it takes for each sample of NaCl to go into solution. Use various sizes of particles of NaCl as samples to test.

Temperature = 21C, 69.8F

Pump Rate = 85ml/minute

Sieve size	Sample Weight (g)	Starting time	Ending time	Total dissolution time
below #16	23.0	1:39pm 6/18/03	9:21 6/19/03	2hrs. 40 min.
		1/3 left after	sitting all night	agitation time

Comments;

Color for the "Below #16 sieve" is very green. As the sample was dissolved into solution, the color changed to neutral, colorless.

Time of dissolution too long using the pump at the specified rate. Will use stir bar and plate, set at moderate rate.

EXPERIMENT

Procedure- Using Magnetic Stir Bar and Plate, dissolve a **23/77 ratio of NaCl to water**, by weight. Set the speed of the plate to #3. Record the temperature of the mixture. Record the time it takes for each sample of NaCl to go into solution.

Temperature = 22C, 71.6F

Sieve size	Sample Weight (g)	Starting time	Ending time	Total dissolution time
below #16	23.0	8:22am	8:33am	11 minutes
#16	23.0	10:41am	10:45am	4 minutes
#8	23.0	10:29am	10:32am	3 minutes
#4	23.0	8:39am	8:49am	10 minutes
#3/8	23.0	8:51am	9:01am	10 minutes
#1/2	22.9	10:06am	10:16am	10 minutes

Comments;

Larger sizes dissolve at similar rate. Smallest gradation dissolves slowest. Will try to dissolve another

sample of "Below #16" sieve size. Cannot explain green color for some gradations.

Temperature = 21C, 69.8F

Sieve size	Sample Weight (g)	Starting time	Ending time	Total dissolution time
below #16	23.0	12:27pm	12:35pm	8 minutes
#3/8	23.1	12:38pm	12:50pm	12 minutes

Comments;

The smallest grade sample, which is also the most intense green of all the gradations, took approximately the same amount of time to dissolve as the first run.

The #3/8 retention sample had substantial amount of insoluble particles as did the first 3/8 sample. Will have to figure the percentage of impurities per sample.

#8 sample, which dissolved the fastest with the least amount of visible impurities, tested 114.25% Sodium Chloride. #3/8 dissolved in 10 minutes and had the most visible impurities, tested at 84.06% NaCl.

#### Impurities

After dissolution of samples there were undissolved impurities present. Samples will be rerun to try and find percent impurities.

#### Results On Impurities

Procedure- Drain off excess water from dissolved solution. Dry in oven @ 105C for approximately 4 hours. Weigh and record any remaining residue. Find the percent impurities from the sample weight.

### Percent Impurities

Sieve size	Sample Weight (g)	Impurities Weight (g)	Percent Impurities
below #16	23.0	negligible	0
below #16	23.0	negligible	0
#16	23.0	negligible	0
#8	23.0	0.6729	2.9
#4	23.0	negligible	0
#3/8	23.0	4.7941	20.8
#3/8	23.1	5.5719	24.1

### Conclusion

The rate of dissolution of NaCl into water is profoundly effected by the method of agitation. Using a pump to circulate water in order to dissolve NaCl particles is a slow process. A more vigorous form of agitation greatly increases the rate of dissolution.

Stirring NaCl particles and water with a stir bar at a moderate decreases dissolution from hours to minutes. The size of the three largest particles was equalized by the stirring method. The samples from sieve sizes, #4, #3/8, and #1/2 all took 10 minutes to dissolve.

NaCl check samples from the districts typically contain CaCl<sub>2</sub> , and MgCl<sub>2</sub> .In order to understand the effect that these salts have in the dissolution process of NaCl to form Brine, the next part of this project will involve the dissolution rates of pure reagent grade NaCl, CaCl<sub>2</sub>, and MgCl<sub>2</sub>.

6/23/03

### EXPERIMENT

Procedure- Using reagent grade NaCl, CaCl<sub>2</sub>, and MgCl<sub>2</sub>, find the time it takes to dissolve a 23g/77g salt to water ratio in the manner described above. Do each salt as duplicate samples.

Temperature= 23C, 73.4F

Reagent Salt	Sample Weight (g)	Total dissolution time
NaCl	23.0	5 minutes
NaCl	23.0	4 minutes
CaCl <sub>2</sub>	23.0	3.5 minutes & heat
CaCl <sub>2</sub>	23.0	4 minutes & heat
MgCl <sub>2</sub> x6H <sub>2</sub> O	49.0	3 minutes
MgCl <sub>2</sub> x6H <sub>2</sub> O	49.0	3 minutes

### Conclusion

The reagent grade NaCl had a dissolution rate that compared closely to the two finer gradations of the 97% pure NaCl field samples, the #16 sieve retention and the #8 retention sample sizes.

The reagent grade CaCl<sub>2</sub> had a dissolution rate that was close to that of the pure NaCl, as did the MgCl<sub>2</sub>.

The main factor effecting the rate of dissolution for NaCl solutions would seem to be the method of agitation.

M. Kerestly