



## Application Note AN-PAN-1025

# 使用索制法行和水制分析含量

### 概要

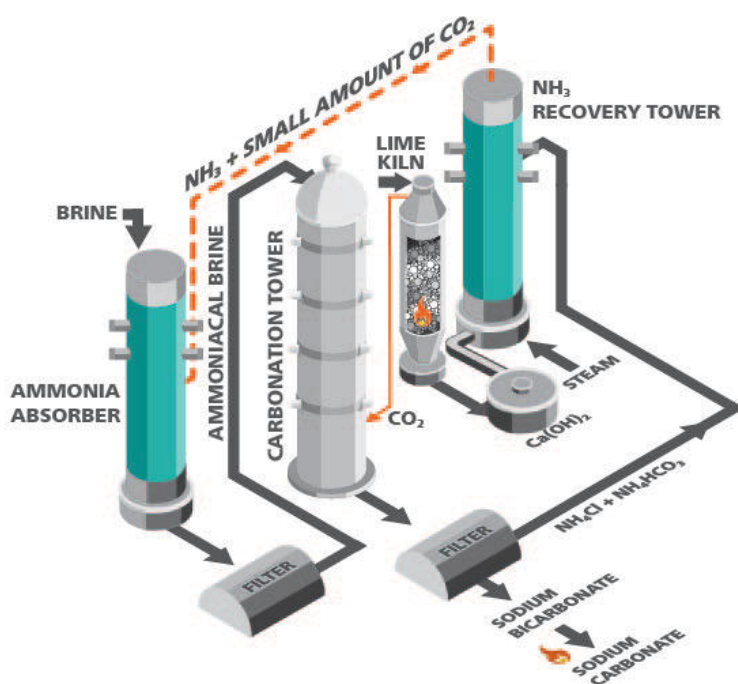
During the Solvay process, ammonium bicarbonate and sodium chloride are converted into sodium bicarbonate and ammonium chloride. Heating the former compound yields sodium carbonate (soda ash), an important raw material used to make several commonly used products. Ammonia is recovered almost completely through the conversion of the ammonium chloride with lime milk ( $\text{Ca}(\text{OH})_2$ ). This Process Application Note describes a

method to continuously monitor the ammonia content online in the saturated sodium chloride brine solution after the absorption tower, thus guaranteeing optimal product yield in the carbonation tower. The [2035 Process Analyzer - Potentiometric](#) from Metrohm Process Analytics is the ideal solution to monitor ammonia and more in the Solvay process (e.g., alkalinity, carbonate, chloride, calcium oxide, and carbon dioxide).

Soda ash, otherwise known as sodium carbonate ( $\text{Na}_2\text{CO}_3$ ), is a key chemical in the production of many goods, such as glass, soap, and paper, as well as for treating water and scrubbing sulfur compounds from smokestack emissions. There are two ways to manufacture soda ash: the industrial Solvay process or mining from ores (trona and nahcolite). The Solvay process is most commonly used in Europe, where the mining of ores is not economically feasible [1].

The major components necessary for the Solvay process besides water are limestone ( $\text{CaCO}_3$ ), brine (saturated  $\text{NaCl}_{(\text{aq})}$ ), ammonia ( $\text{NH}_3$ , 10–35%), and carbon (coke) for the lime kiln (oven) (Figure 1). First, ammonia gas is absorbed into a concentrated brine solution. The

limestone is heated, producing  $\text{CaO}_{(\text{s})}$  (used in a final step) and  $\text{CO}_{2(\text{g})}$  which is mixed with the ammoniated brine in a carbonation tower to form ammonium bicarbonate ( $(\text{NH}_4)\text{HCO}_3$ ). This intermediate can easily degrade on its own, but in the presence of the brine solution it reacts further to create  $\text{NH}_4\text{Cl}$  (ammonium chloride) and  $\text{NaHCO}_3$  (sodium bicarbonate). The sodium bicarbonate is then removed by filtration and heated to produce the final product: soda ash ( $\text{Na}_2\text{CO}_3$ ). The  $\text{CaO}_{(\text{s})}$  (left over from heating the limestone) is mixed with water (slaking) to form  $\text{Ca}(\text{OH})_2$ , which is used to recover  $\text{NH}_3$  by reacting with the  $\text{NH}_4\text{Cl}$  solution. Ammonia is then recycled within the process (Figure 1).



**Figure 1.** Illustration of the Solvay process used to manufacture sodium carbonate when mining for ore is not economically feasible.

## INTRODUCTION

Timely and effective monitoring of brine chemistry is critical for maintaining the efficiency and safety of the ammonia saturation process. Manual analysis of the brine stream is undesirable since the obtained data does not represent the actual process conditions. Metrohm Process Analytics process analyzers are able to monitor the amount of ammonia in

saturated brine after the absorption tower and help to adjust the concentrations to ensure a good product yield in the carbonation tower. Additionally, an alarm indication can be immediately sent to the control room if ammonia concentrations are out of specification.

## APPLICATION

Sample acidified with HCl is accurately titrated with a NaOH solution. The endpoint indication is performed with a combined pH electrode, and the result is

calculated as ammonia using a 2035 Process Analyzer - Potentiometric (**Figure 2**).



**Figure 2.** 2035 Process Analyzer - Potentiometric for accurate online determination of ammonia in brine streams.

**Table 1.** Measured parameter in saturated brine streams.

Parameters	Concentration [g/L]
$\text{NH}_4^+$	55–135

## REMARKS

Other online applications are available for soda ash manufacturers such as alkalinity, carbonate,

chloride, calcium oxide, carbon dioxide, and hardness.

## CONCLUSION

Metrohm Process Analytics offers automated online process solutions to monitor ammonia in saturated brine around the clock. The 2035 Process Analyzer - Potentiometric can measure not only ammonia, but it

is also suitable for monitoring alkalinity, carbonate, chloride, calcium oxide, carbon dioxide, and hardness to optimize process efficiency.

## RELATED APPLICATION NOTES

[AN-PAN-1005 Online analysis of calcium and magnesium in brine](#)

[AN-PAN-1059 Online analysis of strontium and barium in high purity brine](#)

## BENEFITS FOR ONLINE ANALYSIS IN PROCESS

- **Increased final product quality** due to constant online monitoring
- **Fully automated diagnostics** – automatic alarms alert process operators immediately for corrective actions when brine streams are out of set specification parameters
- **Safer working environment** with automated sampling and analysis



## REFERENCES

1. Jones, T.; Dunwoodie, M.; Boucher-Ferte, V.;  
Reiff, O. *Chemicals for Beginners*; Vth edition;  
Deutsche Bank, 2011.

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## CONFIGURATION



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