

USING LIME FOR ACID NEUTRALIZATION

A PROVEN SOLUTION!

LIME MEETS THE ENVIRONMENTAL CHALLENGE: In today's industrialized society, many processes create acidic waste streams. Wastewater discharge permits generally require that acidic waste be neutralized to the range of pH 6.0 - 9.0. In the future, many facilities may be forced by changing permit requirements to treat and reuse all wastewaters. To achieve these goals, lime neutralization is the best solution.

LIME IS THE NEUTRALIZING MATERIAL OF CHOICE: Neutralization of acidic waste streams involves raising the pH, usually by adding an alkaline chemical, such as lime. There are several other chemicals that can also be used, but due to cost, handling problems, high total dissolved solids in the effluent, or mobility of heavy metals in the sludge, lime is the neutralizing material of choice. As highlighted in the table below, when considering the cost of neutralizing agents and alkali requirements, lime is the most cost-effective option to neutralize acids.

Comparison of Common Neutralizing Materials¹⁻³

<i>Product</i>	<i>Lime (Calcium Oxide or Hydroxide)</i>	<i>Soda Ash (Sodium Carbonate)</i>	<i>Caustic Soda (Sodium Hydroxide)</i>	<i>Magnesium Hydroxide</i>
<i>Form of Material</i>	Solid - CaO Powder-Ca(OH) ₂ Slurry 35%-Ca(OH) ₂	Powder - Na ₂ CO ₃ Solution 15%-Na ₂ CO ₃	Solution 50%-NaOH	Slurry 58%-Mg(OH) ₂
<i>Alkali Requirement Per Ton H₂SO₄ Per Ton HCl</i>	As CaO: 1,240 lbs. 1,670 lbs.	2,160 lbs. 2,900 lbs.	1,630 lbs. 2,190 lbs.	1,190 lbs. 1,600 lbs.
<i>Cost Per Ton of Neutralizing Agent (on a dry basis)</i>	CaO - \$60 Ca(OH) ₂ - \$80 Slurry Ca(OH) ₂ - \$100 Cost Stable	Na ₂ CO ₃ - \$80 Cost Variable	NaOH - \$280 Cost Highly Variable	Mg(OH) ₂ - \$300 Cost Increasing
<i>Cost to Neutralize 1 Ton of H₂SO₄</i>	CaO - \$37 Ca(OH)₂ - \$66 Slurry Ca(OH)₂ - \$82	Na₂CO₃ - \$86	NaOH - \$228	Mg(OH)₂ - \$179
<i>Maximum pH @ 25° C</i>	12.45	>11	14	10.6
<i>Sludge Profile</i>	Heavy, Low Volume, but easy handling, even if heavy metals present	High Volume, gel-like when heavy metals present	High Volume, gel-like when heavy metals present	Heavy, Low Volume
<i>Salts</i>	Insoluble calcium metal hydroxyl salts	Soluble sodium salts	Soluble sodium salts	Soluble magnesium metal hydroxyl salts
<i>TDS (total dissolved solids)</i>	Low	High	High	High
<i>Reaction Time</i>	Moderately fast-acting to complete neutralization	Moderately fast-acting to complete neutralization	Extremely fast-acting to complete neutralization	Fairly slow-acting to 95% complete neutralization

Factors to consider when choosing a neutralizing material include the cost of the material, the amount of sludge produced, the handling characteristics of the sludge, the leaching characteristics of the sludge, and the resulting quality of the effluent.* Lime is most economical, but also offers other advantages.

Caustic soda and soda ash are generally less effective--yielding the lowest volume of sludge and the highest dissolved solids content in the effluent. These neutralizing agents also tend to produce gel-like and hard-to-handle sludges. Furthermore, the heavy metals contained in the sodium-based sludges are highly leachable. Therefore, unless the acid waste stream is extremely clean, these two materials can be easily eliminated from consideration.

For most waste streams, the two leading neutralizing candidates are lime and magnesium hydroxide. Lime neutralizes more quickly and completely, which can reduce the size of equipment. Magnesium hydroxide yields somewhat less sludge per unit volume than lime. However, magnesium hydroxide effluent is generally higher in total dissolved solids.

Lime is the neutralizing agent of choice in almost all applications. Lime sludges are heavy, low volume, easy to handle, and easy to clarify. Most metals contained in the sludge are insoluble and will not readily leach into the environment. Finally, lime is the low cost reagent in terms of neutralizing value.

For more information, including on-line ordering of NLA's bulletin on *Acid Neutralization with Lime*, check NLA's website at <http://www.lime.org>. For more technical information, contact your local lime supplier (a list appears on the website above).

REFERENCES:

- (1) *Acid Neutralizers Calm the Wastewaters*. Hairston, Deborah W., *Chemical Engineering*, Dec. 1996.
- (2) *Acid Neutralization with Lime*. National Lime Association, Bulletin No. 216, 1995.
- (3) *Comparing Acid Waste Stream Neutralization Methods*. Teringo, John, *Plant Engineering*, Nov. 1990.

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* Reactions between acids and alkalies are exothermic and sometimes violent. Thus proper (normal and customary) safety precautions should be strictly followed.