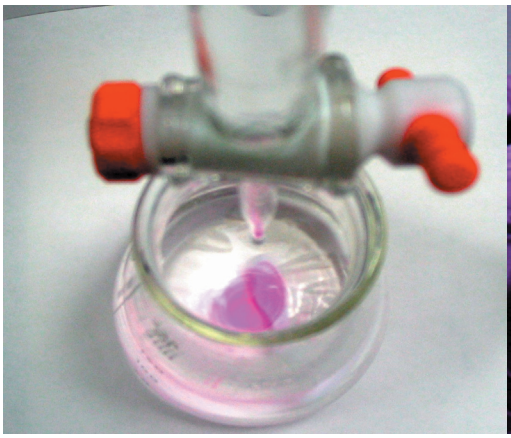
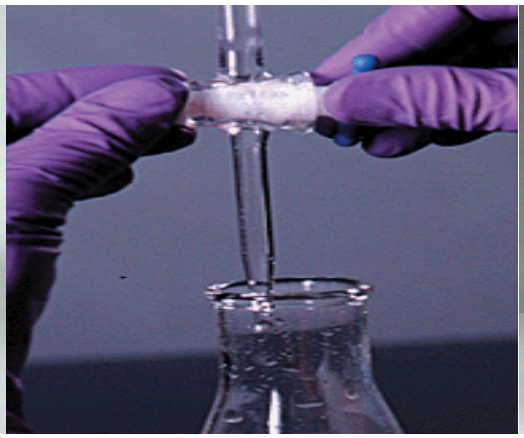


TECH TIPS

Issue #7 April 2006

How to Measure Caustic Strength

In many of the cleaning applications we use products that we commonly refer to as containing caustic, or more specifically the products contain sodium hydroxide. Since sodium hydroxide is essential for effective cleaning in the use solutions it is important for us to be able to ascertain the sodium hydroxide concentration or free caustic strength of the use solution.

In chemical terms we express the strength of sodium hydroxide as % sodium hydroxide (%NaOH) or grams of sodium hydroxide in 100ml. To do this we normally carry out a titration of a sample of the use solution with an acid of known concentration e.g. sulfuric or hydrochloric acid, using phenolphthalein as an indicator.

This sounds simple enough. However there are more and more applications where the use solution is recovered, restored to the desired strength with the addition of fresh sodium hydroxide, and reused again. These solutions are exposed for long periods of time to the carbon dioxide in the air which reacts with the sodium hydroxide to convert it to sodium carbonate.

$$2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$$

Examples of reused solutions include CIP solutions in the dairy, beverage or brewing industry and bottle washing caustic solutions. In fact, in some CIP applications in brewing, the CIP caustic solutions are often sent into tanks which still contain considerable quantities of carbon dioxide, which can instantly render the sodium hydroxide ineffective by turning it into sodium carbonate.

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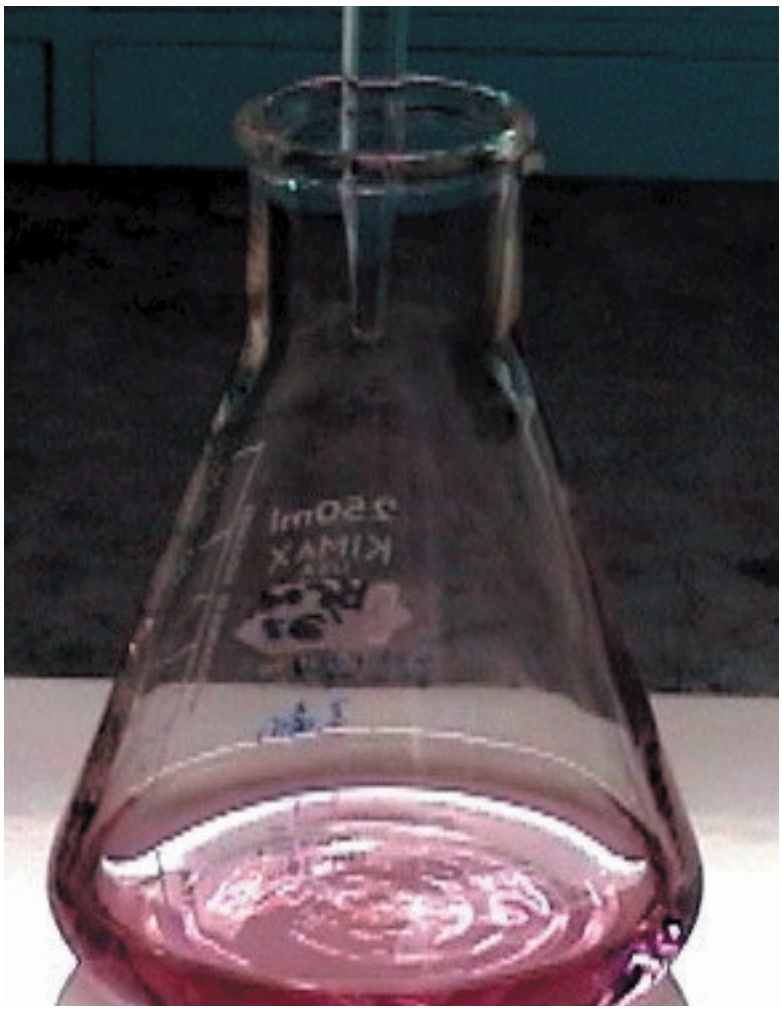

Unfortunately the simple titration with phenolphthalein mentioned above does not distinguish between carbonate and sodium hydroxide and we can easily be fooled into thinking that the solution contains sodium hydroxide when in fact it could be mostly carbonate. Sodium carbonate does not have the same cleaning punch as sodium hydroxide. In situations where we suspect the presence of carbonates, it becomes very important to be able to distinguish how much of our solution is really sodium hydroxide (free caustic) and how much is actually sodium carbonate.

Luckily, we can make a simple modification to the phenolphthalein titration by introducing a second indicator bromophenol Blue. JohnsonDiversey dropper Test Kit #409224 used in the food group includes these indicators and the titrating acid. If the test kit is used with the procedure described below we can distinguish between free the concentrations of sodium hydroxide (caustic) and sodium carbonate in the use solution.

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1. Obtain 10ml of sample of the solution to be tested.
2. Add 3 drops of Phenolphthalein Indicator and mix. The solution should be pink.
3. Add 9.0N Sulfuric Acid, drop by drop, mixing after each addition and counting the number of drops until the color changes from pink to colorless.
4. Record the number of drops when the solution turns from pink to colorless (a).
5. Add 3 drops of Bromophenol Blue and mix. The solution will now turn blue if carbonates are present.
6. Starting counting from zero, add the 9.0N Sulfuric Acid drop by drop with mixing and count the number of drops until the solution color changes from blue to yellow.
7. Record the number of drops (b).

Calculation: $(a - b) \times 0.120 = \%NaOH\ w/v$

$b \times 0.318 = \%Na_2CO_3\ w/v$

The method can be carried out using a burette and 2.5N Sulfuric Acid on a 10.0ml sample. Instead of counting the drops in steps 4 and 7 the volume of acid in milliliters is recorded. Va and Vb.

Calculation: $(Va - Vb) \times 1 = \%NaOH$

$Vb \times 2.65 = \%Na_2CO_3$

There are other variations of this test that you may encounter in the field. One of the more common, described here involves the use of barium chloride. In this method two samples labeled A and B, each 10.0ml, are taken. Barium chloride is added to sample A. If any carbonate is present this will precipitate as barium carbonate leaving behind any free caustic. Sample A is titrated with standard acid using phenolphthalein as indicator giving the hydroxide content. Sample B is titrated with standard acid using bromophenol blue as indicator. By Subtracting the acid volume of titration A from the acid volume of B, the carbonate can be obtained.

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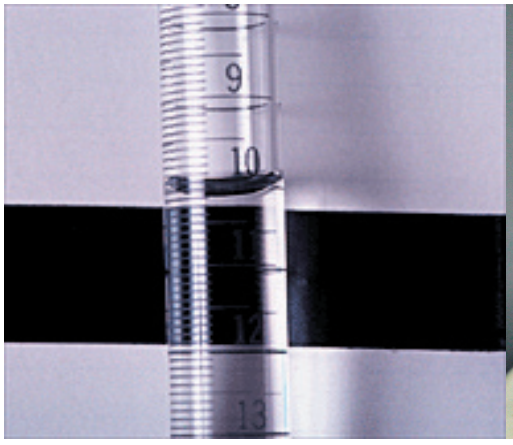
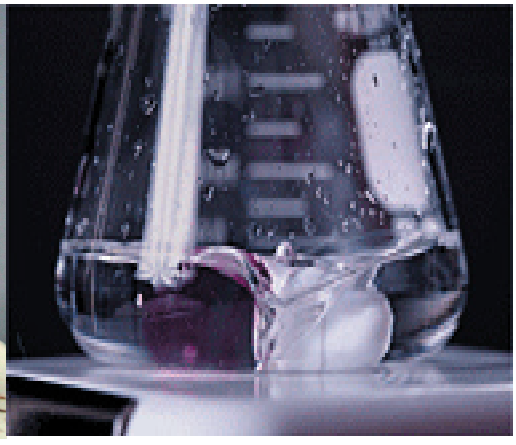
One final note …..
In the field, the concentration of sodium hydroxide (free caustic) is measured indirectly by using conductivity. The use of conductivity to record the concentration of free caustic is acceptable if the use solution is mostly sodium hydroxide with little sodium carbonate. For example a use solution of say 3% sodium hydroxide (NaOH) and a 1% sodium carbonate (Na_2CO3). This is possible because at the same concentration the conductivity of sodium hydroxide is much larger than that of sodium carbonate. However keep in mind that the measurement of conductivity is not specific to sodium hydroxide. Therefore, high concentrations of sodium carbonate do interfere and give false readings for the concentration of sodium hydroxide (NaOH). For example a solution containing 5% sodium carbonate and 0% sodium hydroxide is sensed as a 1% solution of sodium hydroxide.





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