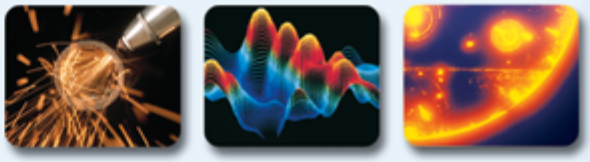
Chemistry in Action



Skunk-Spray Remedy

Have you ever given your pet a tomato juice bath to get rid of the smell of skunk spray on its coat? Chemistry has a much better way of conquering skunk spray.

Paul Krebaum, the inventor of a new "deskunking" formula, says that while working as a materials engineer, he constantly had to deal with the less-than-pleasant smell of the hydrogen sulfide gas that was released from one of his experiments. Venting off the gas only partially solved the problem. A better solution would be to eliminate the smell entirely.

Mr. Krebaum rifled through his old chemistry books and found that hydrogen peroxide could oxidize these sulfur-containing compounds to much less smelly components. He immediately whipped up a hydrogen peroxide mixture, and it worked like a charm.

The equation below shows that hydrogen sulfide reacts with H_2O_2 to form sulfate compounds that do not have a bad odor.

$$2NaOH + 4H_2O_2 + H_2S \longrightarrow Na_2SO_4 + 6H_2O$$

"The receptors that are in your nose are sensitive to sulfur in its low oxidation state," says Mr. Krebaum. "However, they are not sensitive to sulfur in its high oxidation state."

Some time later, a friend of Mr. Krebaum's complained to him that a skunk had sprayed his pet.

▲ *Skunk spray gets its odor from chemicals called* mercaptans.

Because the odor in a skunk's spray also comes from compounds containing sulfur in a low oxidation state, Mr. Krebaum thought his solution might also work on this age-old problem. He mixed up a milder version to try out on the pet: 1 qt of a 3% hydrogen peroxide solution, 1/4 cup of baking soda, and 1 tsp of liquid soap. His friend tried it out, and the result was one wet and unhappy—but much less smelly—pet.

Mr. Krebaum says that the hydrogen peroxide in the remedy actually oxidizes the compounds, while the baking soda reduces the acidity of the mixture and the soap helps to wash out the greasy skunk spray. This reaction can be seen in the following equation. The symbol *R* represents all the other elements in the sulfur-containing compound that is in skunk spray.

$$RSH + 3H_2O_2 + NaHCO_3 \longrightarrow RSO_3Na + 4H_2O + CO_2$$

The pet should be thoroughly washed with the mixture, and care should be taken to avoid the eyes. If the mixture is left on for a few minutes—long enough for the reaction to occur—and then rinsed away with tap water, the smell will disappear.

The formula does not bleach or cause any other negative side effects. Mr. Krebaum does have one warning: Mix the formula just before using it, because the mixture breaks down quickly. The reaction releases oxygen, so the formula should not be kept in a sealed container. Pressure will build up, and the lid could eventually blow off. For this reason, bottles of "Krebaum's Skunkinator" will not be appearing on drugstore shelves any time soon.

Questions

1. How did Paul Krebaum's research into the properties of H_2S result in a benefit to dog owners?
2. What are some possible packaging designs that Paul Krebaum could have used if he had wanted to sell his formula?