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Erythritol Tetranitrate & Nitrated Sugar Substitutes (New Explosive Threats)

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INTRODUCTION

Within the last year, a new series of energetics has started to emerge in Internet forums dedicated to explosives, as well as in the labs of "kitchen chemists." This series of materials is based on the conversion of common sugar substitutes, known as sugar alcohols, to explosive compounds. This bulletin is designed to familiarize first responders with these new threats and the materials which could indicate their potential presence.

BACKGROUND

In the quest for sweetness without corpulence, numerous sugar substitutes have emerged throughout the years. These sweeteners can be divided into two main categories: non-nutritive and sugar alcohols. Non-nutritive sweeteners, as the name implies, contain no nutritional value and provide no calories. Compounds such as Saccharin, (found in Sweet 'N Low®) and Aspartame (contained in Equal®) are well known examples of this family of sweeteners. These zero calorie sweeteners are not related to the new explosive threat and should not be an item of concern if found.

However, in an attempt to utilize more natural alternatives, a series of chemical compounds referred to as "polyols" or "sugar alcohols" has gained popularity amongst those with both sweet tooth and spare tire. These chemicals provide sweetness with reduced caloric potential, containing approximately half the calories of sugar. Some of these commercial products are displayed in the photograph on the right. Mannitol, xylitol and erythritol are three of the more common examples of these sugar substitutes. They can be found packaged in large bags, jugs and small packets.

ERYTHRITOL TETRANITRATE

Of the sugar alcohols available, erythritol seems to be the most commonly utilized in the production of improvised explosives. For this reason, it will be the main focus of this bulletin. The chemistry of the other sugar substitutes will be analogous to that described for the erythritol.

One way of converting these sugar substitutes into explosives is by adding them to a solution comprised of a mixture of sulfuric and nitric acid. However, strong nitric acid is not readily available on the commercial market and therefore bomb makers tend to use other chemicals. Another method to convert the sugar substitutes to explosives is to add them to a mixture of sulfuric acid mixed with ammonium nitrate (AN). This pathway to nitration is popular with the kitchen chemist, as it mitigates the need for strong nitric acid which is more difficult to acquire. Both sulfuric acid and AN are very common and can be found in commercial products [1,2].

Sulfuric Acid **Ammonium Nitrate (AN)**

Sulfuric acid in high concentration levels is desirable and can be found in the form of professional drain line openers such as the Liquid Fire™ depicted in the photograph above. Other brands such as Rooto® or Liquid Lightning are also widely available to the general public. The sulfuric acid found in battery acid is much more dilute than that found in drain openers, and therefore not as optimal for nitration reactions. However, the presence of any form of sulfuric acid should be taken as a potential indicator of explosive production and warrants a more detailed examination for other chemicals.

AN can be found in a variety of forms such as fertilizer and cold packs. The adjacent picture shows the external and internal view of a common cold pack, which is a very popular source of the material for home experimenters. AN and a water bladder can be seen in the opened pack's interior.

The AN recovered from cold packs, as well as that utilized in fertilizers, is in the form of miniature BBs referred to as "prills." The photograph below depicts prills and a water bladder that have been isolated from a cold pack.

It should be noted that the AN from cold packs can be utilized to produce a variety of explosives on its own. This is accomplished by adding a variety of fuels ranging from diesel to powdered metals, such as aluminum. The presence of prills is another indicator that potential explosive production is occurring at a location.

Erythritol Nitrate (ETN) is prepared through the combination of AN, sulfuric acid and the erythritol sweetener. Typically, the reaction will be conducted in a cooled vessel. Once all of the erythritol has been converted to ETN, the solid material is filtered from the acid solution. The presence of coffee filters seated over mason jars or t-shirts spread over buckets can be indicative of such a filtration process and have been seen in actual cases.

To neutralize the residual acid contained on the filtered ETN, the final product is typically washed with a solution of baking soda (sodium bicarbonate) dissolved in water. In any clandestine laboratory search, the presence of basic compounds such as baking soda or sodium carbonate should be noted. These could be indicative of explosive production.

When dry, ETN is a white crystalline solid. A photograph of recrystallized ETN prepared in the FBI Laboratory is provided on the right.

SUMMARY

A new family of explosives produced from the conversion of sugar substitutes is being encountered. Responders need to be cognizant of the chemical precursors used to make these materials. Most commonly encountered is erythritol; however, mannitol and xylitol can also serve as precursors for improvised explosives. Any of these sugar substitutes encountered in the presence of strong sulfuric acid of nitrated salts, such as AN, should be cause for concern.

ETN is an extremely sensitive explosive which can react unpredictably. Bomb technicians should be contacted immediately if precursors for ETN or any of the other sugar based improvised explosives are discovered.

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REFERENCES

1. "Improvised Explosives Precursors," FBI Bomb Data Center, Investigators Bulletin 2009-1.

2. "Explosive Peroxides," FBI Bomb Data Center, Investigators Bulletin 2006-2.