The Knowledge Bank at The Ohio State University

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Explosives is a devastating word! It is usually connected with whole city blocks torn asunder; hospitals and churches lying in veritable ruins; huge gaping holes in the walls of school buildings and libraries; peaceful villages leveled to the ground; farm land covered with yawning craters; shadowy hulks settling to the ocean floor; vast steel skeletons crumpling into rivers—but do you know how explosives are prepared and how they compare in physical and chemical properties?

The word explosive is derived from the Latin verb "explodere" meaning to drive out or to drive out with clapping. Explosives are substitutes which easily react at comparatively low temperatures with the formation of a considerable volume of highly expanded gas, the evolution of heat and light, and the production of sound. Under standard conditions of temperature and pressure they may be solid bodies like gunpowder, liquid like nitroglycerin, or gaseous like fire damp mixtures. They may consist wholly of a single chemical compound like mercuric fulminate, or mixtures of combustible substances with supporters of combustion or oxidizing agents like blasting powder, which is a mixture of charcoal sulfur, and sodium nitrate.

This article will deal with the preparation of three distinct types of explosives generally known as gunpowder, guncotton, and mercuric fulminate. Their characteristic differences in sensitivity and explosive power also will be discussed.

Testing Instruments

There are two instruments of immense value in determining the differences in sensitivity and explosive power of explosives. The first of these is a simple device to record the sensitivity of an explosive substance. It consists of a perfectly flat square of steel with a rod rising from each corner perpendicular to the plane of the base. These rods ascend four feet into the air and are connected together by welded steel strips. Inside this rectangular prism is another square of steel weighing two kilograms with a rod fitted through each of its corners, leaving it free to ascend or descend with little loss of motion. A small rope is attached to this plate and is extended through the top of the prism. The lower surface of this block is flat and parallel to the surface of the base. One of the rods is graduated in centimeters and half centimeters. The two kilogram weight is raised and dropped on the explosive. The height to which it must be raised to cause the explosive to "fire" is a measure of detonating powder required to set off the explosive. This is the mechanical shock instrument.

The Trauzl lead block is used for determining the explosive power of a substance. This is a block about 20 centimeters square made of chemically pure, soft lead with a hole bored in the middle 15 centimeters deep and 25 millimeters in diameter. The explosive is packed in the cavity of the block and a fuse is attached. The increase in the cavity of the block is a measure of the explosive power. Although this instrument does not give exact results, it is accurate enough to serve the purpose of comparing the explosive power of certain types of explosives.

Gunpowder

Probably the best known of all explosive substances is gunpowder. It has been utilized by man for centuries as a propellant, and even centuries before that, was employed in the making of fire-works. Gunpowder is very easily produced in the laboratory since it is a mechanical mixture. It consists wholly of nitre (potassium nitrate), sulfur, and charcoal. Quite some care should be taken in the selection of these materials to insure a gunpowder with a high efficiency. The nitre should be near chemical purity, have no action on litmus, and be quite free from the chlorate and perchlorate of potassium. It should contain very little chloride as it will become deliquescent. The sulfur used must contain no sulfuric acid as it will react with the nitre. For this reason roll sulfur is used and ground down. The charcoal should be of the finest quality containing no impurities, since the quality of the gunpowder depends greatly upon it.

Great care should be taken in the preparation of gunpowder that the friction of grinding does not raise the temperature of the mixture to its kindling point.

Gunpowder consists of 75 parts by weight of nitre, 15 parts by weight of charcoal, and 10 parts by weight of sulfur intimately ground together, in a mortar until they form a finely divided uniform mixture. This mixture must not come in contact with moisture, as gunpowder that has become damp and then dried loses some of its power. Sodium nitrate is being widely used in (continued on page 20)
For years telephone cables have been spliced in a very satisfactory way. But the solder joint contained 40 per cent war-vital tin.

So Bell System men devised a new type of joint which saves up to 30 per cent of the solder. A “Victory Joint” they called it.

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Saved! Tons of tin!
place of potassium nitrate in gun-
powder because of its lower cost and
the added power it imparts to the
mixture. Care must be taken, how-
ever, in its manufacture and storage
because of its hygroscopic properties.

If a one gram sample of the gun-
powder is placed upon the steel base
of the mechanical shock machine, it
will be found that the shortest drop
of the two kilogram weight which
will explode the mixture is about 70
centimeters. This varies somewhat
with each mixture and very notice-
abley if sodium nitrate is used instead
of nitre or if the components contain
many foreign substances.

A ten gram weight of gunpowder
packed tightly in one gram of tin foil
with a fuse projecting from one end
and placed in the bore of the Trauzl
lead block will enlarge the cavity of
the block 100 cubic centimeters when
exploded. This test must take place
with the explosive covered by finely
divided sand so as to utilize the full
explosive power of the substance.

Guncotton

Guncotton is a nitrocellulose com-
pound used chiefly as a propellant
in small arms. In its storage it should
be kept free from water, otherwise
it will lose some of its energy. Cot-
ton waste is employed in the prepara-
tion of guncotton, but it must first
be thoroughly cleaned and washed to
remove oil. The acid used in the re-
action is approximately twenty-five
per cent nitric acid and seventy per
cent sulphuric acid in solution with
water. The waste cotton is dipped in
this mixed acid and allowed to re-
main for five minutes. It is then
wrung out and placed in water cooled
containers for nitration to take place.
After several hours the excess acid
must again be wrung out and the cot-
ton plunged into a bath of cold water.
If the resulting substance is insoluble
in an alcohol and ether mixture, it is
guncotton; otherwise the nitrating
process much be continued until the
correct results are obtained.

The weight on the mechanical shock
machine must be dropped ten centi-
meters to explode the guncotton after
it has been dried. The test with the
Trauzl block shows a cavity of nearly
three hundred cubic centimeters when
the substance is exploded.

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Molecular Keys
To A New World

VAST NEW SOURCES of raw materials ... the equivalent of those which might be found in a great new continent ... opened to America when CARBIDE AND CARBON CHEMICALS CORPORATION, a Unit of UCC, started building synthetic chemicals from water, salt, air, and hydrocarbons.

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The Prest-O-Lite Company, Inc.

PLASTICS
Bakelite Corporation
Plastics Division of Carbide and Carbon Chemicals Corporation
INGREDIENTS TO MOVE MOUNTAINS
(Continued from page 20)

Mercuric Fulminate

Mercuric fulminate is in almost universal use as a detonator for blasting charges because of its rapid acceleration and the fact that it is not unduly dangerous to handle when proper precautions are taken. Nevertheless, it is expensive and does not keep well and for this reason lead azide is coming into more general use.

Mercuric fulminate is prepared by dissolving five grams of mercury in 45 grams of nitric acid. The solution of mercuric nitrate thus obtained is cooled to room temperature, and 50 milliliters of 95 per cent ethanol (ethyl alcohol) are added. After the reaction has subsided, the mercuric fulminate should be cooled and thoroughly washed in cold water. It must then be filtered from the solution and kept moist until just preceding its use. All during the reaction an ample draft must be provided to draw off the fumes, as they are very poisonous.

Mercuric fulminate can be exploded by dropping the two kilogram weight of the mechanical shock machine just two centimeters. Its explosion in the Trauzl lead block displays a cavity of approximately two hundred and seventy-five cubic centimeters.

Comparison of Explosives

From these tests it has been shown that the sensitivity of an explosive and the force of its explosion is considerably less in a mechanical mixture than in an explosive in which the combustion takes place completely within the molecule. The kinetic energy of an explosive substance is also contingent upon its deliquescent properties and the chemical purity of its constituents. To prepare an explosive with a high efficiency, only the purest substances available should be used.