TNT EQUIVALENCY OF EXPLOSIVE SOURCES

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TNT equivalence has long been used as a measure of the blast energy released by explosive sources. The reasons why TNT equivalence is used, rather than the amount of energy released, will be discussed, and methods for determining the equivalence will be described. It will be shown that, for most explosive sources, it is invalid to use a single value for the TNT equivalence. Examples will be given showing the variation of TNT equivalence with distance for a number of different explosives. The deficiencies of using TNT as the standard explosive will be discussed, but it will be suggested that insufficient information exists at this time about any other explosive that would justify its use as an alternative standard.

When energy is released rapidly from a centered source, it generates a blast wave with a specific set of physical properties. The nature of those properties depends on the proportion of the released energy that is contained in the blast wave, and on the rate at which the energy is released. For example, in the case of a nuclear explosion, approximately 50% only of the released energy is contained in the blast wave, and the remainder appears as nuclear and thermal radiation. In this case, however, the rate of energy release is very rapid. At the other extreme, such as a BLEVE or a thermo-baric explosion, the amount of energy released depends on the degree of mixing with atmospheric oxygen, and the rate of release is very slow in terms of a detonation phenomenon.

For the above reasons, and others, rather than describing the amount of energy released from an explosion, it has been found more useful to compare the properties of the blast wave generated by an explosive with those from a charge of TNT and to quote the quantity of TNT which will produce similar blast wave properties at the same distance from the center of the explosion. TNT has been used for this purpose, rather than another explosive, because more data are available about the physical properties of the blast waves produced by TNT in the free air, at a wide range of heights of burst, and detonated on the ground surface. Some of the disadvantages of using TNT as the standard explosive are: that it cannot be detonated, uncased, in amounts less than about 5 kg, which precludes it use in small scale experiments, and it exhibits a considerable amount of after-burning. The latter phenomenon has little affect on the hydrostatic pressure history, but a notable affect on the dynamic pressure in the later stages of the positive phase.

It is suggested that in order to replace TNT as the explosive standard, an extensive series of experiments would be required to develop an adequate database of physical properties of blast waves produced by an alternative candidate. In the interim, there appears to be a need for a better understanding of the determination and use of the TNT equivalency protocol, and these aspects will be discussed and illustrated in the presentation.