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AMMONIUM NITRATE BLASTING AGENT (ANFO)
FOR LAND CLEARING

The introduction of "prilled" AN has revolutionised explosives practice and made possible safer and cheaper methods of blasting.
This article outlines the methods of handling and using ANFO blasting agent for land clearing.

By G. A. GREAVES, Inspector of Explosives, Mines Department

EXPLOSIVES are commonly used for blasting out stumps and trees on farmland but farmers have heard of a new method of blasting which does the work at a fraction of the cost. This article is for general information and guidance of those who have not yet employed the new blasting agent and who are seeking advice on the method.

Ammonium nitrate (AN)
Ammonium nitrate (AN) has been used for many years as an ingredient of commercial mining explosives and in military explosives it is used in mixtures with TNT as the main charge in bombs and shells. It is not only an oxidising agent but it also behaves as a very insensitive explosive in itself. When mixed in the correct proportion with some form of combustible matter it can be detonated.

Before 1958 the only AN available was a crystalline form which made very insensitive explosive mixtures and required the addition of nitroglycerine or TNT for effective detonation. The introduction of "prilled" AN has revolutionised explosives practice and made possible the safer and cheaper methods of blasting which are now used. The prilled form of AN is manufactured as tiny rounded pellets which are so porous that they will absorb completely sufficient liquid fuel to make a balanced explosive mixture. Diesel fuel oil is the most convenient form to use and the proportion is six per cent. by weight.

A good porous AN prill forms a free-running mixture in which the oil is fully absorbed in intimate contact with the nitrate. This mixture is generally known as "AN-FO Blasting Agent" or simply "ANFO". It is capable of producing a high velocity explosion and when initiated by a suitable primer it will do the same amount of work as a nitroglycerine explosive of the conventional type.

Ammonium nitrate in the prilled form is available from several sources. It is manufactured by I.C.I.A.N.Z. Ltd. at Botany, New South Wales and further quantities are imported from U.S.A. and Japan. It is packed in either multi-wall paper bags or in heavy-weight polythene bags. Most of the bags contain 50 lb. of AN but 80 lb. bags are available and the Japanese product is in 30 kilogram (66lb.) bags.

AN is hygroscopic and if left exposed to the air it will absorb moisture and become caked or damp. Open bags should, therefore, be folded over and closed so as to exclude moisture.
There is a lot of discussion and many varied opinions on the dangerous properties of ammonium nitrate. Under certain conditions it can be made to explode alone without addition of oil and in the past there have been some major disasters in the shipping and storage of AN. Since the production of the prills, which are coated with a small amount of inert material, the record has been good and AN is not classified as an explosive. Certain precautions, however, are necessary and the most important are:

(a) never store explosives close to bags of AN;
(b) take all precautions against fire in and about the storage.

AN will melt and run in a fire and when further heated it will decompose and produce oxygen. In this way it is dangerous in a fire and can cause violent reactions or even explosions.

Ammonium nitrate is classified as an oxidising agent. There is no restriction on its sale, transport or storage as there is for explosives and it may be purchased without a permit or license. Because of its danger in a fire, certain conditions are applied to its carriage on railways but there are no restrictions for road transport.

It must always be remembered that fire is the greatest hazard and additional fire precautions should always be taken when AN is conveyed or stored. It should be stored in a clean shed with a concrete floor or the bags can be kept in steel drums or some other steel container. It should never be stored where spillage from broken bags can come in contact with jute bags, organic fertilisers or feed stuffs.

**ANFO blasting agent**

The mixture of AN with oil is an explosive mixture which can be made to explode and the operation of blending AN and oil can be regarded as the manufacture of an explosive. Until a few years ago all explosives were made in licensed factories and this “do it yourself” method presented a problem. In some States it was covered by special licenses issued for manufacture at the place of use, but in Western Australia ANFO was classified not as an explosive but as a “blasting agent.”

In this State the Explosives Regulations provide that the mixing of AN and oil to make blasting agent shall be done under a “License to Manufacture a Blasting Agent.” The license applies only to the one type of mixture and is subject to certain rules which are specified on the license.

The main restrictions are:

(a) ANFO blasting agent shall be manufactured only on the property where it will be used;
(b) it shall be manufactured only in the quantity required for immediate use.

Any person who intends to mix and use ANFO blasting agent should first apply by letter for the license and enclose the license fee of $2. Applications should be addressed to the Chief Inspector of Explosives, Treasury Building, Perth. The license is renewable annually on payment of the license fee.

ANFO blasting agent is now used extensively in Western Australia at all mines and quarries and has even been adapted to underground use. It was at first thought that fumes from the explosions would be too dangerous for underground work but this problem has been overcome by careful control of the mixture and efficient ventilation. Nevertheless the use of ANFO in mines is carefully controlled by the Mines Inspectors and a permit must be obtained from the Senior Inspector of Mines at Kalgoorlie for the use of ANFO underground. ANFO mixture is readily desensitised by water and in wet conditions operators in mines or quarries usually revert to the use of gelatinous explosives.

**Stump-blasting with ANFO**

The use of ANFO blasting agent in mining was found to reduce explosive costs to less than one half and farmers soon became aware that this might apply to land clearing and stump-blasting. It has been tried for this purpose and despite some initial scepticism, the method has now established itself as a cheaper and equally effective means of obtaining results.
The mixture cannot be used in wet holes unless it is enclosed in a plastic bag but otherwise the free running ANFO will completely fill the most irregular holes and when properly primed it produces a very powerful explosion.

There is sometimes an illusion that ANFO blasting agent is a cheaper and a lower grade explosive which is safe to use. It is cheaper, but it can produce a high velocity explosion which has the same danger potential as any other explosive. It is safer only in one respect, in that ANFO mixture is less sensitive than gelatinous explosives and can be handled more safely. Nevertheless it is still an explosive which is made to explode and should be treated with care and with due respect for the power potential which is in it.

The blasting of stumps and trees is done by placing charges in holes which are usually made with a post hole digger or a power boring unit.

The amount of charge needed is difficult to estimate since it depends to a large extent on the nature and hardness of the soil and on the type and condition of the stump or tree which is being blasted. It is obviously better to make trials first with small charges than to cause damage or injuries by overcharging at the first attempt. After a few trials it will be possible to place the right amount of charge in the right places to produce the desired result. The greatest danger is from flying timber fragments which can damage vehicles or other property and also cause severe personal injury.

Allow sufficient time for ALL PERSONS to take cover at a safe distance and always make sure the area is clear before firing. Safety fuse has a reliable burning rate of 3 feet in 90 seconds and with a pocket watch it is easy to see just when the charge is likely to fire. With electric firing there is no delay and firing can be done at any desired moment when all is clear.

**Priming of ANFO**

ANFO is not as sensitive as gelatinous explosive and must, therefore, be primed with suitable primers. There are various ways of doing this and the manufacturers’ agents through their technical service departments have published their recommendations in pamphlet form.

Whatever method is used it is most important that the primer be adequate for the purpose. It has happened that the farmer is so interested in reducing the cost that he uses a primer which either misfires the charge of ANFO or fails to initiate the charge to its full potential. He then usually blames the nitrate for a misfire or for a poor result. ANFO is an explosive which requires a boost or overdrive of sufficient strength to propagate the reaction and effective results will not be obtained unless sufficient primer is used.

Two methods are recommended for priming of ANFO and detailed information is available from the technical service departments of the explosives agents.

One method is to use an ordinary stick of gelignite which is broken into two halves, taped together to form a more compact mass. This is fired either by safety fuse and detonator or by means of detonating fuse. An electric detonator could also be used if a firing cable and an electric exploder are available. Detonating fuse is a thin plastic tube filled with a high velocity explosive. It is fired by means of a detonator taped onto the end of the fuse and burns instantaneously with a speed of 4 miles per second. The trade names for detonating fuse are “Cordtex” and “Primacord” and both are capable of firing by direct communication to a primer.

The other method of priming is to use a special explosive mixture containing TNT. This can be purchased as small hard blocks with holes through which the detonating fuse is inserted and tied in place. This type of primer is not fired directly by a detonator and it is always necessary to use the detonating fuse method. With either method of priming it is essential that the explosive primer be placed securely within the ANFO charge so as to ensure effective firing.

A number of stump holes can be charged with ANFO and all the primers connected together by lines of detonating fuse. The lines are joined together and can be all fired simultaneously from one No. 6 detonator which in turn is fired either electrically or by safety fuse.
Full details of these methods of priming and firing are described in pamphlets published by the manufacturers' agents who have also given practical demonstrations in some country districts. Further demonstrations can be arranged if farmers can organise the attendance of a sufficient number of people at a field day.

Mixing of ANFO

In mines and quarries, ANFO is usually batch-mixed as required by using a small rotary concrete mixer. The required amount of AN is poured into the mixer and a measured volume of distillate oil is added. After turning in the mixer for a few minutes, the product is ready for use, but it may be allowed to stand for one or two hours or longer to achieve full absorption of the oil. The required amount of oil is three pints for a 50 lb. bag of nitrate.

For stump blasting ANFO can be mixed in an oil drum by stirring the mixture with a broad wooden stick or it can be "rolled" on a sheet of plastic material.

Galvanised iron stirring equipment—or containers—should not be used, since there is a dangerous reaction of zinc with ammonium nitrate.

The mixed ANFO can be taken to the blasting site in a steel drum fitted with a lid or in the original plastic bags.

Care is necessary to avoid mistaking the mixed ANFO for untreated AN since there is little difference in the appearance and it is for this reason that a red dye is sometimes added to colour the mixture and so avoid any mistake.

Do not mix more than is required for the day's work and remember that the mixture is an explosive which is made to explode, and that it can explode. It must not be left in sheds or vehicles and should never be placed near any working machinery.

Safety with explosives

Since conventional explosive materials are necessary as primers for ANFO it is necessary to observe all the usual precautions for handling and using explosives. All explosives should be kept in a clean carrying box which is marked "Explosives" and the proper equipment should be obtained for fuse capping and also for the firing of electric detonators if they are used.

Remember that safety fuse burns at 3 feet in 90 seconds—never uses less than 3 feet of safety fuse for any firing.

A misfire should be left well alone for at least 30 minutes before approaching the site to investigate.

Detonating fuse is regarded as high explosive and may be kept or stored with other explosive primers but detonators must always be kept separately in a special box and treated with care.

On account of their small size, detonators can easily be lost or go astray in a motor vehicle; accidents have occurred in garages when vehicles were afterwards being repaired. Always keep detonators in a securely closed or locked box and put them away in a safe place at the end of the day.

Sources of information

Any farmer who seeks further information about stump-blasting with ANFO is advised to write to the Explosives Division of I.C.I.A.N.Z. Ltd., 171 St. George's Terrace, or to Marine and Industrial Power Co. Pty Ltd., 198 Wellington Street. Both these companies can supply the explosives, the nitrate and the "know-how."

Anyone wishing to gain a broader knowledge of explosives and their application in mining and in agriculture should obtain a copy of the book Explosives for Engineers by C. E. Gregory (Queensland University Press). A new edition of this book was published in 1966 and it would be a useful addition to the farm library. Blasting handbooks are also published by DuPont and I.C.I.A.N.Z. Ltd. and can be obtained from the agents at their Perth offices.
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