

ANFO Explosives

Ammonium Nitrate (AN) As An Oxidizer - Background

Ammonia is made from nitrogen and hydrogen which combine together under high pressure in the presence of catalysts. Ammonia is then oxidized to nitric acid using air in the presence of platinum. Hot ammonium nitrate is formed by neutralization of ammonia with nitric acid. The concentrated AN solution can be used in several forms or it can be used in watergel and emulsion explosives.

It is well known that ammonium nitrate is a very popular oxygen carrier in explosive mixtures. It is also used in rocket propellants, since it is a totally gasifiable oxygen carrier. It is very soluble in water (a saturated solution contains about 65% NH_4NO_3).

Transitions in different crystal forms happen at 125, 84, 32 and -17 degrees C. The greatest problems associated with its use are its caking and hygroscopicity.

Hygroscopicity of ammonium nitrate was considered to be the major cause of caking.

Although this is just one part of the problem, in the last two decades the polymorphism of crystals has been recognized as the critical factor. It was found that at 32 degrees C, a phase transition occurs. Also found was that hardening occurs during the process of cooling ammonium nitrate heated above 32 degrees C. Some substances have a great influence on the change. If the ammonium nitrate is chemically pure and free of water a different transition (phase IV to phase II) happens at 50 degrees C. This is not as undesirable as the transition from phase IV to phase III. The repeated transition between phases III and IV results in the generation of fine particles which cake readily through the absorption of moisture. For this purpose anti-caking substances are used. Surface active substances (surfactants-stearates) are very helpful as anti-caking agents. However the effect of these substances on the thermal stability of ammonium nitrate can be very important. An organic substance increases the sensitivity of ammonium nitrate.

The already mentioned hygroscopicity of ammonium nitrate is its other drawback. Ammonium nitrate can be protected against moisture by mixing it with substances such as calcium or zinc stearate, petroleum tar, asphalt, barium sulphate and guar gum powder. Stearates have particle sizes roughly 5 mm-20 mm in size while ammonium nitrate has particle sizes of 70 mm-120 mm. Thus a small proportion of stearates is sufficient to cover ammonium nitrate particles.

Ammonium nitrate becomes an explosive when mixed with a carbonaceous additive (fuel) in the correct oxygen balanced proportion. Sensitized with a fuel, a patent for such an explosive was issued to two Swedish scientists in 1867. The importance of this discovery did not materialize until 1955. The family of ammonium nitrate carbonaceous lasting agents is a simple mixture of ammonium nitrate and some form of combustible material such as carbon black, powder coal, sawdust, sugar, molasses, but more generally fuel oil.

Some organic substances lower the thermal stability of ammonium nitrate. A recent experience is the accident which happened in 1978 in Tunisia. According to an investigator, the floor of the storage house was covered with saw dust. The saw dust reacted with the ammonium nitrate causing a temperature rise and ignition. Finally detonation occurred (80 tons of ammonium nitrate).

Ammonium nitrate is currently marketed in the following forms:

Grained Ammonium nitrate. It looks like fine sugar, cakes and it is used only in dynamites.

- Porous Prills. Their size is -6-14 mesh. They flow freely with anti-caking agents.
- High Density Regular Prills. They are hard prills made for agricultural purposes. Their size is similar to the previous prills.
- High Density Mini-Prills. This is a relatively new type of prill which is very small coated with either calcium stearate or zinc stearate. This product has an increased bulk density of 1.06 g/cc over the regular prills having a density of 0.9 g/cc
- Stengel cubic form.

Only the porous prills are suitable for use with fuel oil directly as a blasting agent. The anti-caking agent used is kieselguhr (2%-3%) or some surface active agent (sulphonates) or combinations of the two.

The mini-prills are also an effective blasting agent but have a higher critical diameter (about 100 mm confined) than the regular porous prills. This product must also be used shortly after being loaded (within one week).

ANFO Types

Grained Ammonium Nitrate:

- Looks like fine sugar - cakes and is used only in dynamites for oxygen balancing - not porous - won't absorb fuel oil

Porous Prills (BGAN):

- Size is -6+20 mesh - flows freely with anti-caking agents - low density 0.85 g/cc - suffers from low bulk strength - not waterproof - can be blown at reach densities up to 1 g/cc

High Density Regular Prills (FGAN):

- Hard prills made for agriculture - won't absorb fuel oil - can be crushed to hold 6% fuel oil - low detonation velocities when mixed with fuel oil - no water resistance



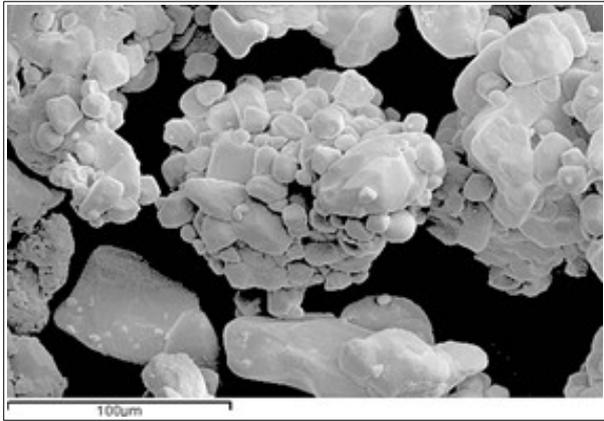
Porous Prilled AN

High Density Mini-Prills:

- New type of prills which is very small size - 8+100 mesh - coated with either calcium stearate or magnesium stearate
- Increased bulk density of 1.06 over regular prills - not waterproof

CHMAN – NEW DEVELOPMENT BY NEXCO:

- Chemically modified ammonium nitrate – micro-particles with mesh size in microns (100 microns largest particle)
- High density, high velocity plasticized ammonium nitrate with binder – very water resistant
- Has C4 appearance, can be made into a variety of consistencies



Micro-particle AN (MPAN) - 100 microns scale

ANFO Usage in the Mining Industry - Surface and Underground

ANFO Detonation Velocity

- Critical diameter unconfined BGAN – density of 0.85 g/cc – 3 in (76 mm)
- Critical diameter confined BGAN – same density – 2.5 in (64 mm)
- Critical diameter unconfined crushed BGAN – density of 0.80 g/cc – 2 inch (50 mm)
- Critical diameter confined crushed BGAN – density of 0.80 g/cc – 1 inch (25 mm)
- Confinement steepens the velocity-diameter curve and lowers the critical diameter

Why ANFO?

- Cheap
- Can be blown into small diameter holes in drifting using pneumatic ANFO loaders
- Fast loading rates using auger type bulk transport vehicles

Why NOT ANFO?

- Velocity – Diameter curve shallow because of grain burning mechanism
- Inefficient crushing using loaders/chargers
- Waste is high – ½ bags are not returned to magazine – left in drift as waste
- Not water-resistant
- Very poor bulk strength – density is not variable – pattern size is small – usually pulled in
- Energy is not variable

ANFO Fumes in the Underground Environment

- Over-fueling leads to carbon monoxide (CO) formation
 - Reaction is oxygen balance negative
- Under-fueling leads to nitrogen dioxide (NO₂) formation

- Reaction is oxygen balance positive
- Underground environment is very humid and wet – avoid using caked ANFO or ANFO that appears to have prill breakdown
- ANFO hazard classification is 1.5 – fume classification is 1
 - Fume Class 1 explosive can be used for any type of underground blasting operations

ANFO As a Blasting Agent

ANFO advantages are related to economy, efficiency and safety. Neither component (ammonium nitrate or fuel oil) is classified as an explosive, but when mixed in the correct stoichiometric proportions and with adequate priming, the mixture becomes a powerful low cost explosive. It can be bulk stored and loaded on site cheaply, thus avoiding excessive costly and restrictive transportation conditions. The components are usually delivered (in bulk) to the site separately, and mixed locally as required (under federal government approval).

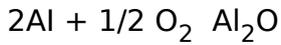
Generally, two types of ammonium nitrate are available for use in blasting operations; low density porous prilled, and high density non-porous prilled ammonium nitrate. The latter type must be treated (usually by crushing) to provide retention of the required 6% fuel oil addition. However there are some other forms of ammonium nitrate also not normally applied to explosives end uses..

Because ammonium nitrate is used on a large scale, it must be remembered that even though this material is not classified as an explosive by itself, several disasters involving its storage have occurred. Ammonium nitrate for use in mining operations is usually shipped by heavy truck or railway car to sheltered structures located at the mine site. Special bulk trucks constructed for transferring the nitrate from building to blast hole are used all having the added capability of blending the ammonium nitrate with the required 6% fuel oil. Free-poured ANFO suffers from the disadvantage of having low density and therefore low bulk strength. The best way to increase the energy of ANFO is through the addition of aluminum to ammonium nitrate resulting in higher energy output compared to just fuel oil. Originally the percentage of aluminum used was low and often other fuels of doubtful use, e.g. such as ferrophosphorous and ferrosilicon were used. In fact, these later so-called ‘fuels’ were simply used to make the ANFO heavy so that it would sink in water.

Aluminum is being used in explosives to increase energy output. Aluminum, when reacting in the detonation process, produces aluminum oxides. The reactions are exothermic and the energy output of the explosive is improved. The graph below shows the effect of aluminum in the energy of ANFO. It is obvious that energy can be increased. However the rate of increase falls-off beyond the 13%-15% Al point. This is probably the upper limit for economic reasons as well. Furthermore at higher percentages the energy output falls off. It should be noted here that solid Al_2O_3 results as a product of reaction. This has energy trapped in it. From blasting studies it is estimated that only 1/2 of the energy which is associated with the solids is available for useful work. A large percentage of aluminum desensitizes the product.

Another disadvantage of the aluminized mixes is the production of hydrogen. This has been particularly serious in underground mining in the past where coarse grained aluminum has been added to explosives with the result that hydrogen was formed in the humid and wet environment of some underground boreholes that were not breakthroughs. Dropping stones or grit down such boreholes in the presence of

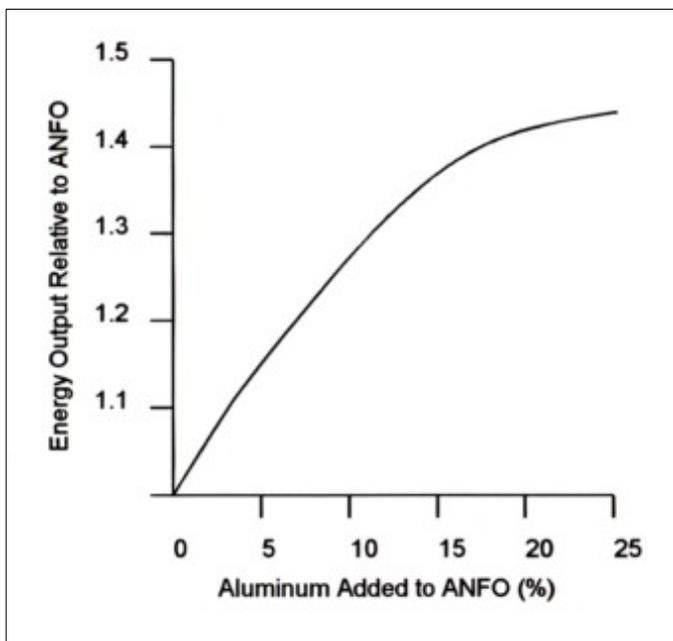
hydrogen caused a localized reaction with some serious consequences. Fine grained aluminum (paint flake or atomized) is added to underground explosives that are completely oxygen balanced so that the likelihood of hydrogen mixed with oxygen from the atmospheric air is an explosive mix which can result in secondary explosions. This happens through the following reactions in the detonation products;



The size of the aluminum grain must be small enough so that reaction can be completed in the detonation head. However there is a limit to the size which is imposed by safety considerations. Aluminum dust can be explosive and the particle size is the most significant factor controlling the explosibility of the dust. It follows that the minimum size of the aluminum grain should not be smaller than 150 mesh. For use in explosives, particle sizes larger than 20 mesh do not react properly since the surface area they provide is small. Thus the largest particles should not be larger than 20 mesh.

The aluminum used in open cast blasting operations is added to the bulk mixed ANFO explosive and delivered by truck using special augers and feeders for surface operations. Specially designed star valves are employed to prevent air from bleeding back into the system. Aluminized ANFO is not used in underground blasting operations. Aluminum in contact with water produces hydrogen when aluminum is in particulate form.

•



Effect of Aluminum Addition to ANFO

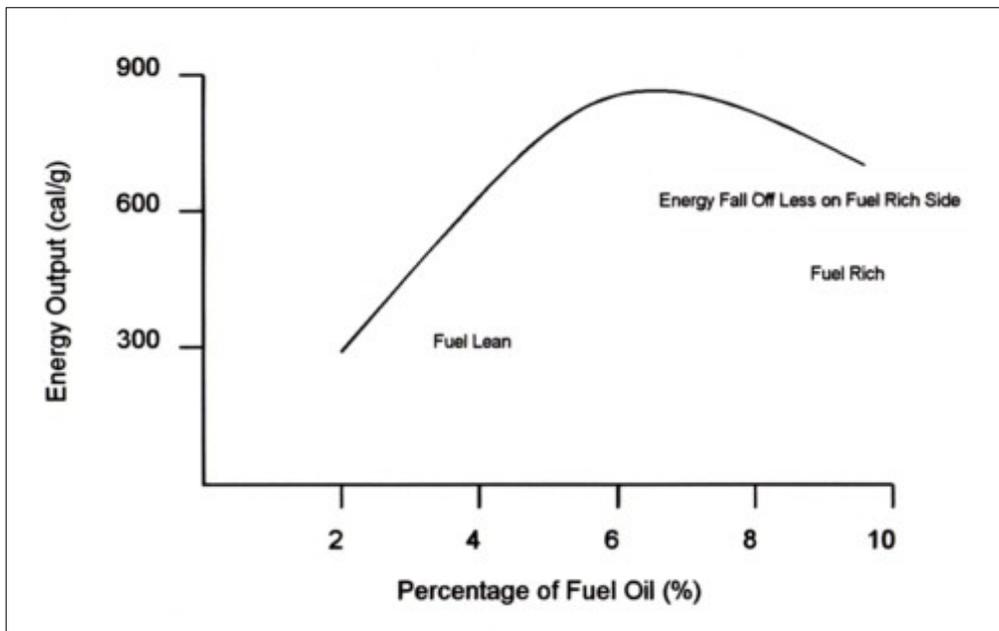
ANFO Water-Resistance Using Guar

Guar added to ANFO in a powder form - it will hydrate when water hits it

- Increases the critical diameter slightly – becomes a fuel in the detonation reaction
- Reduces the hydroscopicity around prills since a mini-gel is formed around each prill
- Very costly ingredient and does not make ANFO waterproof only water-resistant
- Gelling is stable in standing water – will break down under dynamic water conditions
- ANFO bags must be rotated since the fine particle size of guar will cause separation in the container (bag)

ANFO explosives are not confined to open pit mining operations. Pneumatic loaders holding up to several hundred pounds of explosive are used in underground mining operations. Such loaders have the additional advantage of reducing the particle size of ammonium nitrate prills. The crushing of the prills effectively reduces the critical diameter of the explosive so that it can successfully detonate in small diameter boreholes such as those drilled in many underground mines.

The detonation ability of ANFO mixes depends on the reaction rate between the AN particles and the fuel. In order to increase the reaction rate the particle size of the ammonium nitrate can be reduced. However, this method has a limit because ammonium nitrate and oily fuels repel each other. For this reason the action of surfactants has been explored. It was found that anionic surfactants, such as sodium dinaphthylmethane disulfonate, sodium laurylsulphate and sodium dodecylbenzene sulphonate improved the caking characteristics of the mix as well as its detonating ability. The graph below shows the energy output related to fuel oil percentage.



Energy Output with Fuel Oil Percentage

Fuels Used in other AN/Fuels Explosives

The most common fuel used in ammonium nitrate fuel explosives is regular #2 fuel oil. Fuel oil is not viscous and it can be mixed easily. In the case of the mini-prills, Paratac (a tacifier or long chained polyisobutylene) is mixed with standard #2 fuel oil in the range of .1%. This literally causes the fuel oil to 'stick' to the mini-prill.

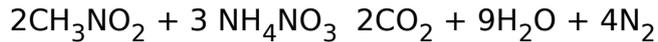
The amount of fuel oil which has to be used is determined by the oxygen balance of the composition. For the oxygen balanced composition



Therefore 14 g of fuel oil is mixed with 240 g of ammonium nitrate. This results in a composition of ammonium nitrate 94.5% and fuel oil 5.5%. This is normal ANFO.

Other energetic fuels can be used instead of fuel oil. When examining the alternatives the areas of concern are: flash point, health hazard, composition variation, ability to mix and blend properly, cost, energy output, viscosity at low temperatures and ability of the prills to hold the necessary quantity of fuel.

In the past nitromethane was proposed to be used with ammonium nitrate. The oxygen balanced mixture is determined by the following equation:



This would result in a composition - ammonium nitrate 67%, nitromethane 33%. It is impossible for ammonium nitrate prills to hold such a quantity of fuel. Nitromethane is highly volatile with hazardous fumes (ignitable by a spark) and is also dangerous to health. To oxygen balance the above equation using nitropropane, the composition would be ammonium nitrate 87%, nitropropane 13%. This is more feasible than the nitromethane case. However nitropropane is volatile with fumes also hazardous to health.

Attempts have been made to use spent lubricating oils. Lubricating oils have flash points higher than fuel oil (150 degrees C-200 degrees C versus 80 degrees C). Fuel retention tests have proven to be satisfactory. However the viscosity of these oils is much higher than fuel oil. As a result the mix is not as intimate as in the case of fuel oil. Furthermore the composition of the used oil is not exactly known.

In tests the compositions with used oil behaved in a very similar fashion as the compositions with fuel oil. A slight difference was noticed only in the critical diameters. In the case of AN/FO (= 0.85 g/cc) the critical diameter is 7.5 cm (unconfined) while in the case of AN/used FO it was 10 cm. Up to 50/50 new/used oil is satisfactory at low temperatures.

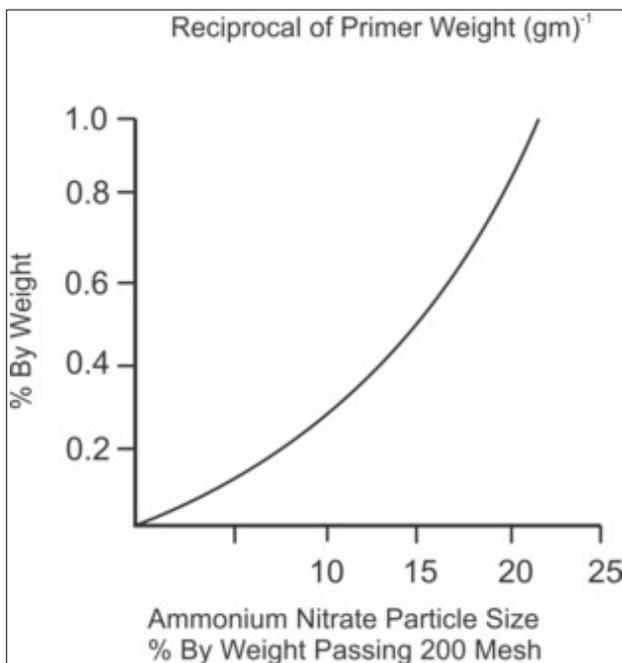
Other fuels which have been tried are coal dust, and sawdust. Even ground up corn husks have been tried (in Chile). All of these pose a problem in mixing. However they can be a promising alternative to fuel oil where the economic conditions are favorable.

ANFO Sensitivity

Various factors affect the sensitivity of AN/Fuel mixes. The major parameters are particle size, porosity, intimacy of mixing and stoichiometry.

- Effect of particle size. Figure below shows the relationship between ammonium nitrate particle size and the sensitivity of the AN/FO product expressed as the reciprocal of the weight of the minimum primer. As particle size decreases - sensitivity increases (reaction rate is increased)
- Effect of porosity: As it was explained before the oxidizer and the fuel have to be mixed well in order to improve the reaction rate. Improving the porosity essentially reduces the particle size. Therefore a similar effect to that of reduced particle size can be obtained by increasing the porosity of the product. However, when dealing with solid fuels, the effect of porosity becomes less pronounced since these fuels cannot penetrate the porous prills but they can only contact external surfaces.

- Intimacy of mixing: From experiments it has been found that the least viscous fuels resulted in the most sensitive product. Fuel and oxidizer phase must be intimately mixed. Improper mixing will raise the critical diameter and suppress the ideal velocity
- Stoichiometry: The most sensitive composition is usually the oxygen balanced one. But this is not always the case. It has been reported maximum sensitivities can occur when the product is either overfueled or underfueled specifically various coatings of the ammonium nitrate prill are used. Stearate coatings are much more sensitive than clay or other mineral coatings.
- Composition: Sometimes sodium nitrate is used with ammonium nitrate because of its low cost and its higher density.
- Density: For the very small sizes sensitivity is not affected markedly by changes in the bulk density between values 0.9 and 1.1 g/cc. The larger prills are affected more. Lowering density increases sensitivity (especially in large charge diameters)
- Water Addition: Ammonium nitrate is hygroscopic and will desensitize ANFO as well as increase the density. Water injection (1%) can be added when loading ANFO in upholes to help pack the explosive material - shoot same day



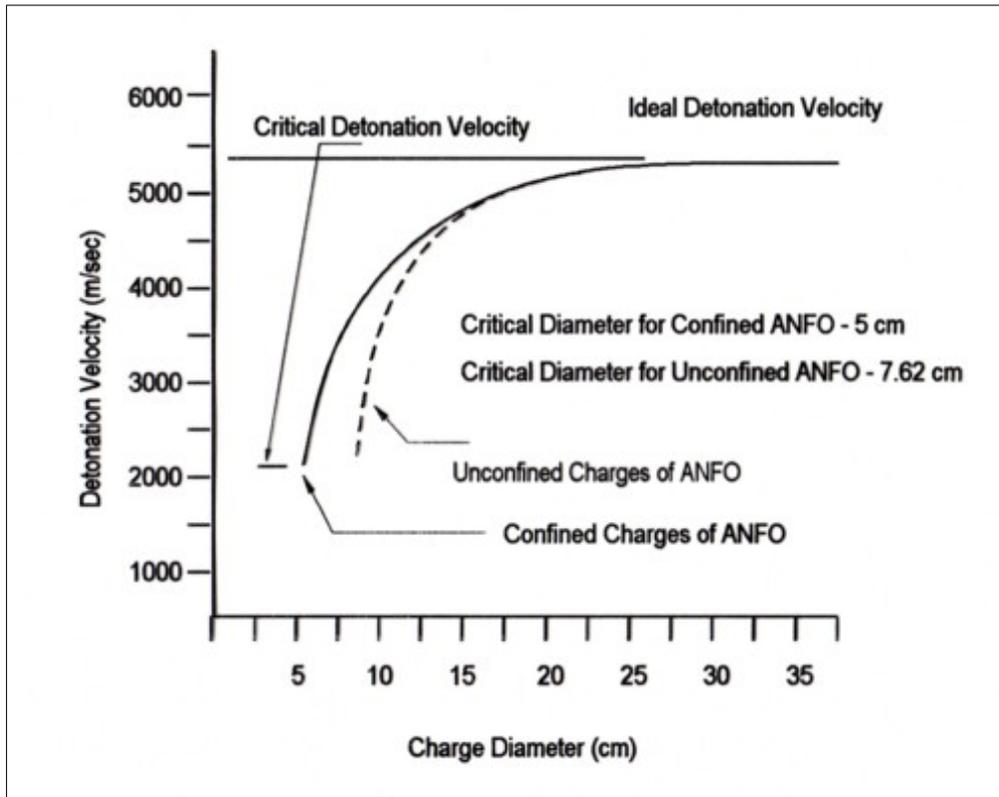
Effect of Particle Size on ANFO Sensitivity

ANFO Detonation Properties - Detonation Velocity

A typical velocity of detonation charge diameter curve for ANFO is shown on the next page in the graph below.

The critical diameter of the prilled product ($\rho = 0.8 \text{ g/cc}$) is 7.5 cm when the product is unconfined. Confinement decreases the critical diameter to about 5 cm. The ideal detonation velocity of ANFO at a density of 0.85 g/cc is 5200 m/sec. From the above curve it follows that ANFO detonates non-ideally even at very large diameters. It has been found that the ideal detonation of ANFO can be achieved when using very strong confinement or using confinement and a very large diameter of charge (in the range of 44 cm).

Factors which affect the ANFO performance are the density, particle size, porosity and composition.



Velocity Diameter Curve for Confined and Unconfined Charges of ANFO

There is some controversy as to the density at which dead-packing occurs for ANFO. Some authors claim that the maximum density at which ANFO can be used is 1.2 g/cc. However, there may be the argument that it depends on how the ANFO is packed within its package. Indeed, with pressed ANFO charges reaching a density of 1.23 g/cc, velocities of detonation have been recorded in excess of 5500 m/sec. This checks out closely with that predicted by the equation given previously in metric units;

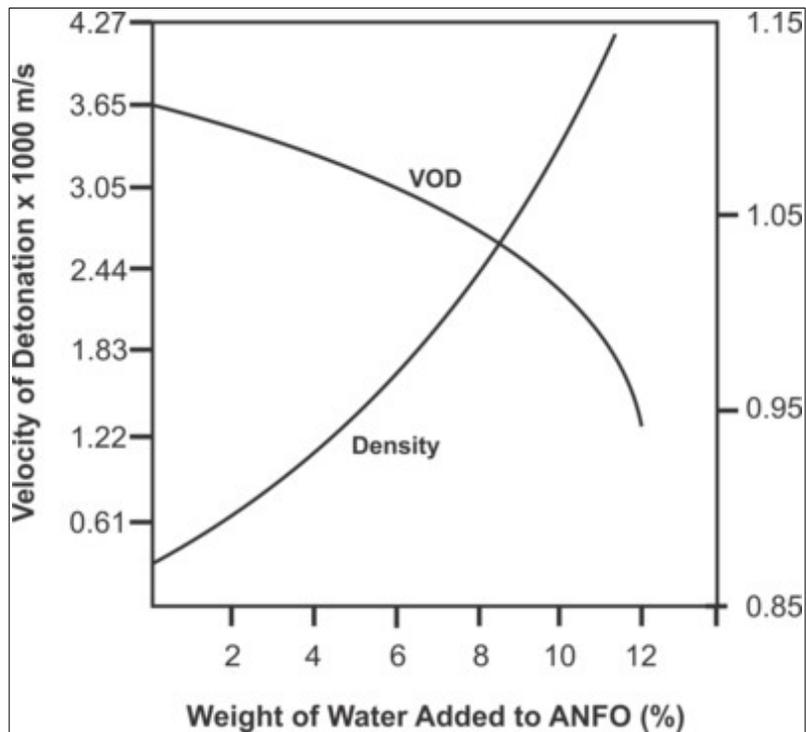
$$D_{\text{ideal}} = 4878 + 3872(\rho - 1.0)$$

where:

$$D_{\text{ideal}} = \text{ideal detonation velocity}$$

$$\rho = \text{ANFO density}$$

A density of 1.2 g/cc will not be achieved by using the prilled product free-poured or tamped. Such a density can be obtained only by crushing and pressing ANFO (hydraulically). The effect of the particle size has been previously mentioned. Smaller AN particle size results in smaller critical diameters. The detonation parameters of ANFO are seriously affected by water in the borehole. Water desensitizes ANFO. The figure below provides a typical example of the effect of water in ANFO. In critical situations, plastic liners are placed in the even in small diameter boreholes in underground mining operations.



Effect of Water Addition to ANFO Detonated Within 5 Hours of Mixing in 100 mm Tubing Using .5 kg Primers

Fumes

Since ammonium nitrate and fuel oil explosives are used in underground mines, the fumes produced from the detonation are of particular importance. The lack of proper control over the preparation of the mixture can lead to serious problems. Minimum amounts of carbon monoxide and nitrogen oxides are produced when the composition is oxygen balanced. ANFO must be primed using a strong primer. Also it is important that the blasting sequence be designed properly so that very small burdens are eliminated

Marginal initiation, water in the boreholes and inadequate burdens can increase the amounts of noxious gases produced. It follows that the amount of carbon monoxide increases dramatically when the oxygen balance of the composition drops below zero. Also the production of NO_2 increases significantly when the composition is underfueled. The same investigators have examined the role of the primer in the production of toxic gases. Underpriming increases the production of nitrogen oxides.

Quality Control

Since the quality of the ammonium nitrate prill is very important for the mixing fuel oil, the following is important;

- Moisture. High moisture in the prill leads to caking which causes poor fuel mixing since it will inhibit the ability of the prill to absorb fuel oil. The manufacturer of ammonium nitrate must examine the moisture content carefully. The porosity of the prills depends on the amount of moisture which is included in the prill prior to the prilling process.
- Density. High density prills do not absorb fuel oil properly. Very low density prills break easily under normal application.

•Particle sizing. The ammonium nitrate prills should be free flowing. Typical particle sizes are given in the following:

+8 mesh	5 - 10%
+10 mesh	50 - 65%
+14 mesh	15 - 20%
+20 mesh	5 - 10%
-20 mesh	0 - 1%

- Oil absorbency. The prills should be able to absorb at least 6% fuel oil (by weight).
- Friability. It determines if the material will break under normal handling. If prills are too friable, they will break into powder during shipping with the result that the protective layer of anti-caking will be lost, thus leading to clumping. These would be broken up prior to use or application of the fuel oil. FGAN prills do not absorb 6% fuel oil.
- Clay content. Water insoluble materials are added to the Ammonium Nitrate as anti-caking agents. These materials are also inert and therefore do not contribute to the detonation reactions.
- Fuel oil content in the final product. The oxygen balance determines the performance, the sensitivity and the fumes of the product when it detonates. Frequent test to determine the fuel oil content should be conducted. Samples must be taken on a random basis. The weight of the sample before and after the extraction gives the weight of the fuel oil.

ANFO Applications - Underground Operations

Dry mixes are used in both underground and open pit (surface) operations. ANFO is not only used by itself, but is also a major or minor constituent in ANFO and emulsion blends. However, it must always be remembered that two key limitations of ANFO in any application are lack of water resistance and low bulk strength.

The underground application of ANFO is influenced most directly by the diameter of the boreholes. Prilled ANFO has a large critical diameter. Underground operations utilize boreholes ranging from 25 mm (1 in) to 153 mm (6 in). It is obvious that if small diameters are used crushed ANFO must be used. Crushed ANFO has a smaller critical diameter than prilled ANFO. Pneumatic loaders are normally used for loading the boreholes. A typical diagram of a pneumatic loader is shown below.

It should be noted that a variety of pneumatic loaders exists. Some of these loaders will crush the ANFO prill in the blasthole by moving it at a relatively high velocity. Thus they achieve high loading densities and good sensitivity of the product (since small particles of ANFO are more sensitive). However pneumatic loading results in static electricity build-ups unless proper procedures are followed. Static electricity can interfere with the electric blasting caps and cause premature detonations. Hoses are made with a special additive in the rubber matrix that will bleed off static electricity for safe handling.



ANFO loading pot that uses compressed air at 624 KPa

ANFO pneumatic loaders permit the use of porous prilled ANFO to be used in small diameter boreholes down to 32 mm only because the prill is crushed to a smaller size allowing the detonation reaction to propagate even when the critical diameter of the normal prill is 50 mm. If the venturi is not cleaned out regularly from the corrosion that occurs following the breakdown of the prills, the airflow velocity will be reduced and the prill breakdown and packing density will suffer. The ANFO blown into the small diameter borehole should be in the density range of 0.95 g/cc-1.0 g/cc. Crushing reduces the critical diameter of the ANFO from 50 mm confined to less than 32 mm confined. However detonation velocity is still low. This means that the detonation velocity is non-ideal and that most of the ANFO ingredients will react outside the detonation reaction zone.

Safety procedures using an ANFO loader are;

- Ground the pneumatic loader.
- Use a conductive loading hose.
- Ground the operator.
- Ambient relative humidity should be more than 50%.

As previously mentioned ANFO is affected by water. The problem is overcome by using proper liners. If static electricity is a problem the liners should be conductive (can use semiconductive ground straps). First the water is blown out from the hole by using the loading hose. Then the liner is attached to the pipe, inserted in the borehole and loading continues as usual.

Open Pit Operations

ANFO is the most popular open cast explosive because of its low cost. In large open pit blasting operations ANFO and aluminized ANFO are handled by special bulk mix trucks. Trucks consist of hoppers for the ammonium nitrate, augers, valves to stop air bleeding back into the system and an air stream or augers to convey the mixed product in the borehole. Trucks are calibrated regularly to maintain quality control of the final ANFO product.

A significant problem in the application of ANFO is its use in wet holes. In underground mines since VRM holes are extremely long compared to open pit or surface mining applications, either emulsion or watergel explosives are used.

However in open cast mining operations, special dewatering equipment has been manufactured to dewater the boreholes before loading. The loading of the holes is then done by using dryliners. These consist of polythene tubing sealed at the bottom. Dryliners can be bought or they can be manufactured on site. The dryliners should be waterproof, free of pinholes and should be strong enough to withstand normal handling. Some dryliners are manufactured so that they are anti-static having trace amounts of conductive material being added during the manufacturing process. Today rapid loading ANFO loaders have been developed which can be used in open pits and quarries as well as underground mines. These loaders compact the material in the blasthole, increasing the density and reducing the particle size of the powder. As a result the economics are improved from the increase of the bulk strength while the explosive detonates with higher velocity of detonation.

Water Resistant ANFO

Recently products called "water resistant ANFO" have appeared in the market. In spite of their name these products should be used after dewatering of the holes. "Water resistant ANFO" contains guar gum which coats the ANFO prills. Guar gum is a long chained crosslinking gum or natural polymer which holds the solid phase of explosives (usually in watergels) together so that there is no segregation. The gum coming in contact with water turns it into a gel. This can reduce small water inflows to the blasthole after the loading of the product. However the gel normally does not react in the detonation wave especially since it has water as one of its main constituents. Thus the effective diameter of the product is reduced at the point where the gel has formed. It should be noted that because of the difference in particle size between the guar gum and the ANFO prills, the small particles of guar will settle out. It is always prudent to rotate the bagged water-resistant ANFO so that the settling process is prevented. When guar gum settles out, pouring the contents into the wet borehole could result in plugs being formed.

The Invention of Micro-Particle AN

Much has been said about AN and its two forms, prills and solution. It was found that mixing special surfactants with AN solution that prilling towers may be relegated to the past since there was a more efficient form of AN particles that could be produced. By efficient, it was found that AN could be made by atomizing AN solution in a flight tube to produce a better form for use in manufacturing a commercial ANFO based explosive that exhibit properties that might make prills obsolete. The entity called Nexco was formed to investigate this technology.

What is the Nexco technology for manufacturing blasting grade AN?

Nexco has developed a new manufacturing process that chemically modifies AN solution to produce an enhanced blasting grade ammonium nitrate (Nexil - MPAN) for both bulk and packaged explosive products.

Why is MPANFO better than regular porous prilled ANFO for blasting operations?

- MPANFO is a high density AN product that is hydrophobic (water resistant) with excellent storage properties. It can be manufactured into a high density, high

detonation velocity explosive. It exhibits user-variable energy properties using a range of moisture contents.

- AN porous prills ranged -8+14 whereas MPAN ranged -200 microns

Why is the MPAN technology considered to be disruptive?

- Has the potential of replacing all existing bulk and packaged explosive products – universal explosive product family from a single plant.

- Low cost manufacturing plant capital and explosive product cost.

- Has the potential of becoming an user-controlled variable energy product that can be pumped into blastholes.

- Opportunity for a minesite to produce its own explosive products.

- Opens up partnership/contracting opportunities with a minesite in control of explosive manufacturing.

- Potentially important savings in terms of explosive storage as well as benefits in safety and environmental considerations (green technology).

- MPANFO is a higher detonation velocity (VOD) and a higher density explosive, exhibiting higher shock (brisance) and higher gas (heave) at a potentially lower cost and better results.

Unfortunately, while a good idea, the capital for manufacturing was not secured.

Seems like this product is stuck as being something ahead of its time.

You can ready more about this technology by following the link. [NewMPANTechnology](#)

References

- From Dr. Alan Bauer course notes

- From Dr P. Katsabanis course notes

- From C. J Preston notes from Queen's University Test Site, Dupont field testing

- From C. J. Preston patents for MPAN and MPANFO