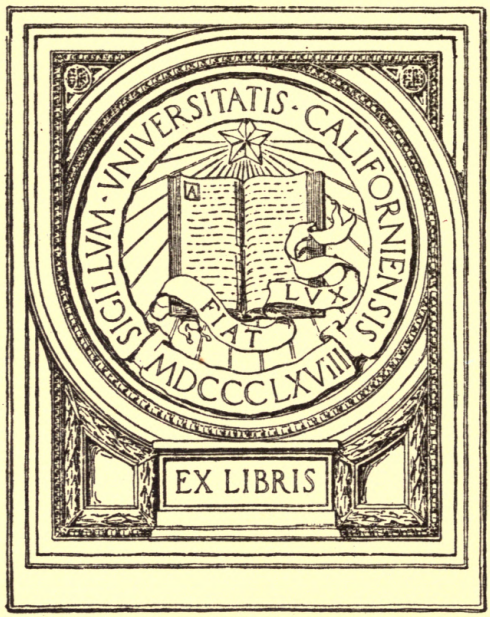
SIGILLVM · VNIVERSITATIS · CALIFORNIENSIS
LVX
FIAT
MDCCCLXVIII
EX LIBRIS

A Practical Study of the Rough Side

of

Nitro-Glycerine

as

USED IN THE OIL AND GAS FIELDS

Willis A. Hill

1915
Press of Democrat Printing Company
Tulsa, Oklahoma

DEDICATED

To the boys who have passed beyond while in the employment of their duty, and whose sacrifices have made it possible and necessary for us to learn the finer points of one of the most essential and useful articles of commerce of the present century.

WILLIS A. HILL,

PREFACE.

The intentions of this little book is to give a few practical and useful hints on the nature of Nitro-Glycerine to all those who handle it as a vocation, and especially to those whose duties force them to come in close contact with the same and who cannot rightly judge when it is or is not handled properly, thereby putting themselves at a disadvantage in protecting life and property. Where anyone is fortunate enough to gain an unusual advantage for observation, study and collection of facts, it is right for them or him to give those facts to their fellow workmen.

WILLIS A. HILL.

The writer wishes to hereby give due credit to Mr. George W. Van Vliet of Pleasantville, Pa., whom he considers to be one of the best authorities on the subject of Nitro-Glycerine.

INDEX

NITRO-GLYCERINE: PAGE

Its true name and how formed 7
Its formula and weight 7
Products of combustion 7
Important points while washing 8
Firing of, with remedies 9
Why some of it does not freeze 10
Some of the dangers while handling 11
Expansion and contraction 11
Why it burns 12
Its ability to escape into dangerous places.....12
The effect of age on 12
Tests for 13
The dissolvent for and possible results 13
Classing of explosives and why 14
Tamping of shots in wells.....14
Why it cannot be replaced for shooting oil and gas sands 14
The results of shots in solid and broken mass..15
The results on top of the ground with suggestions 15
The dangers of—to casing in wells 16
The results of shots in the propellant class on oil and gas sands 16

The principal feature of 17
The overburning of oil sands with suggestions.17
The governing of shots for the different sands and directing the same. 18
Shooting of gas wells 18
The thawing of Nitro Glycerine at wells 18
Preparing cans of stock for transportation.....19
The filling of closed shells at wells and dangers of same 19
A simple test of expansion 20
A common belief as to the effects of dynamite.....20
Shooting of casing and tubing collars in wells 21
A word as to the so-called high prices of Nitro Glycerine 22
Frequent queries and criticism of the Nitro as used today 23
An Apology 23

NITRO GLYCERINE.

Nitro Glycerine is a nitric ether of glycerine. Since glycerine is a try-atomic alcohol, it is formed by the replacement of three atoms of hydrogen by three nitro groups. It is to be considered as an ether of nitric acid. The proper name should be "Nitric-Glyceride". With nitro glycerine as with gun cotton, sulphuric acid is necessary as an intermediate agent to constantly keep the concentration of the nitric acid up to the required degree, that is, to take up the water formed during the reaction. The sulphuric acid helps to precipitate the nitro glycerine. Since the latter is soluble in both concentrated sulphuric acid and nitric acids, but not in a mixture of both. If too great an excess of one or the other be taken, part of the nitro-glycerine is dissolved, and the yield is diminished.

Mixing in large quantities, the available nitric acid at the end of the process, is too much dispersed throughout the mixture, and the oil running in, is not at once attacked by the nitric acid.

The formula for nitro-glycerine is C3 H5 (No. 3) 3. its specific gravity at 60-F is 1.599. The weight per quart at 60-F, is 3 pounds 5 1-3 ounces. The freezing point is 46.4-F.

One kilogram of Nitro Glycerine should give 1,135 litres of gaseous products. The temperature of com-

bustion of Nitro Glycerine is 3005-C or 5441-F. The quantity of energy given off by 1 kilogramme, is 6050.48 kilogramme metres.

Nitro Glycerine explodes at a temperature of 360-F. The per cent composition by weight of Nitro Glycerine is:

Carbon	15.7
Oxygen	63.0
Hydrogen	2.3
Nitrogen	18.8
	98.8

The per cent by weight of products of combustion are:

Carbonic acid	57.6
Carbonic oxide	
Marsh gas	
Oxygen	2.7
Nitrogen	18.8
Water	20.7
	99.8

If Nitro Glycerine be ignited, it burns away in layers until the lower body receives the 360-F., or the exploding point. Perfectly pure Nitro Glycerine will not stand a heating temperature of 212-F for more than a few hours without decomposition.

Nitro Glycerine, or stock as it is more familiarly known, takes the color of the oil that it is made with, providing that it is thoroughly washed. Alkalies and

sodas are unnecessary to cut the acids when washing Nitro Glycerine if temperature of water is kept even at 140 to 150-F. Agitation of wash should be kept low in wash tanks and not above speed sufficient to bring the Nitro Glycerine within 4 or 5 inches of the surface of water. Wash should consume full 60 minutes. This alludes to over-flow wash of one, two or more runs. Chilling the wash by varying the temperature of the water will set the acid and color, and a thorough settling and slow increase of temperature and slow agitation are the most effective remedies.

Motion of paddles should be kept as uniform as conditions will admit.

Stock partially washed and dumped in with raw stock will get away in most every case. The temperature of nearly completed stock should be brought up to that of the raw stock and by itself before mixing same, and then when agitation has been slowed down. Unwashed raw stock dumped in with stock nearly completed, will never wash clear. Nitro Glycerine can be cleared with cold running water but the acid still remains and stock is left in a very dangerous state. When cans of stock are found with pressure on them, it is possible to come from wash that has been passibly cleared, but not allowed to settle before canning. Five minutes extra washing after stock has been cleared is highly recommended.

The pressure from a bad can should never be relieved over or near anything of inflammable nature, and then it is best to lay can down with bottom end slightly raised and cork relieved. A little Nitro

Glycerine wasted in this way, is better than a fired can with no water at hand. After the pressure has been relieved, straighten up can and pour off surface of stock in can. If bad, add a little water before pouring off the acid on top, shaking can thoroughly before relieving pressure helps to reduce the internal pressure. Firing in the washer or grounding tank is caused by excessive temperature and too rank acid water. Dash or spray cold water on same, and notice woodwork closely. Run off rank water as soon as possible, and watch for further outbreaks until cause has been reduced. Too much pick-up added to wash before acid is run off, will cause firing. Excessive oil fed to machine in mixing, together with too rank water in grounding tank, when dump is made, will cause firing in grounder. Stir rapidly. Oil spreaders in nitrator, if turned with inside end of pipe pointing towards the splash of acid, will cause repeated and serious fires. It should be turned with end pointing same direction as motion of paddles. Pipe should be about 7 or 8 inches long and open at end only, with slight decline downward where possible, and pointing midway between coils and shaft. Never over the coil or too near the center of machine. Great care should be used if more than 75 pounds of acid is shy at any one dump. One-half or five-eights of drum of acid should never be attempted to be made up in a 1,500-pound drum nitrator. If necessary to use short drum of acid either weigh out 50 to 100 pounds from other drums and mark same, or make it up in kettles or copper wash boiler of 100-pound capacity, feeding oil very slowly.

In cold weather, it is necessary to warm the oil before feeding it to the acid. If this is overdone, the hot oil coming in contact with the very cold acids, or if the mixture flashes repeatedly, the oil will become parched or stiff and the coating it forms over the drops or globules of the Nitro Glycerine is not affected by decreasing temperatures as readily as the inner globules, and therefore a partial vacuum is formed within, and allows the Nitro Glycerine to stand in an apparent liquid state while it is standing absolutely still, but with a slight movement of the can containing the Nitro Glycerine, these drops or globules collapse instantly, and the entire mass is congealed. Nitro Glycerine, in this state, may be found in batches of whole cans, or lying upon the ice of congealed stock, or in small honeycomb pockets scattered throughout the congealed mass, or it may be lying on top of the cans even when all the stock is frozen within the cans.

For these reasons, it is not safe to force frozen cans, into tight cells of wagons, or crowded too closely in magazines, or handled roughly when carried. Thawed stock is always safest to handle for the reason that it is uniform within the can and the sides and bottom of the cans are plyable and less confined, and less subject to solid jar. Nitro Glycerine is sensitive, and therefore dangerous according to the confinement it is in. This is the most important point connected with the handling of Nitro Glycerine.

The expansion and contraction of Nitro Glycerine, which is 10-121 of its entire volume upon freezing or thawing is so much greater than any other liquid,

and its action in freezing temperatures when the oil has been over-heated or scorched, leads one to believe that the contents of the drop or globules of Nitro Glycerine is a very heavy gas instead of a liquid, for its expansion is equalled by nothing else except gas.

This leads one to readily see why Nitro Glycerine burns. This coating of oil burns off and allows the nitro compound within the globule to escape before the globule has reached the full expansion or bursting point, which is reached only by 360-F, and then slowly for the reason of its being a very poor conductor of heat.

Nitro Glycerine has the peculiar ability of getting through a small opening not equalled by any liquid. Place an ordinary drop of it on a piece of glass and press slightly with point of a toothpick, then observe with small magnifying glass. The results are, that the larger drop will easily break up into numerous small ones, and roll away like quicksilver, and if they should roll near one another, they immediately fly back into their original mass. For these reasons upon a mass of warm or normal Nitro Glycerine approaching a crack or crevice in a tank or trough, can or shell, the drops, from force of gravity, assisted by its oily surface and pliability, immediately break up into the size and shape necessary to pass through and then re-form on the lower side as if by magic.

Thoroughly washed Nitro Glycerine does not lose its strength with age. The case which happened near Hemlock, Pa., where a Swede man and his son were

instantly killed while digging a ditch that crossed an old acid ravine from a Nitro Glycerine factory, from which this nitro had escaped through waste pipes from the factory twelve years before the accident occured, is a fair proof. Again, where empty Nitro Glycerine cans have lain idle for long enough time to oxidize the whole of the inside of cans and then explode violently by placing cap in same. These two cases, together with thousands of others which nearly every man of the oil fields has a sample, are proof that it does not lose its strength with age.

Nitro Glycerine can be scattered through an absorbent to an extent where nothing but very high power caps can reach, and even beyond the power where anything can reach.

Slight traces of Nitro Glycerine can be detected by adding annaline and concentrated sulphuric acid. A purple-red color is shown which can be transformed into green, by adding water.

Wood alcohol, ether or benzine dissolves Nitro Glycerine, and that part that is dissolved is harmless. Believing that there is a reason for all things, then there would have to be a reason for this. Would like to ask this question: Does not the ether, wood alcohol or benzine which has a very high penetrating and contractive effect on anything it is applied to, have the added results, when applied to Nitro Glycerine of penetrating, and contracting the coating of oil over the globule so rapidly and far ahead of the inner nitro compound which is a very poor conductor, that it pulls

the coating off, so to speak, and allows the explosive compound to escape and unite with the elements of the dissolvent or the air and thereby forming other molecules or compounds which are harmless?

The results of combustion of Nitro Glycerine, puts it into the detonator class, which is too instantaneous to seek the place of least resistance. It is an all-consuming flash with a temperature of 5441-F. The power that is developed, is not far reaching in proportion to the amount exploded, as is the case with dynamite, the explosive known as SNG and other powders which are in the propellant class and whose combustion is nothing but an expansion of gases, and which always seeks the place of least resistance.

Tamping of Nitro Glycerine shots in wells with fluid, sand, etc. does not change the nature of the explosive, but does develop power and sensitiveness and drives the flashes farther into the formation that is being shot, according to the pressure of the confining fluids or sands.

All sands as well as everything on this earth is composed of various elements and no two of them have the same melting point, therefore the results of a shot of Nitro Glycerine in an oil or gas sand is to consume those elements in that sand having the lowest melting point, and thereby making the remaining rock porous plus a hard driving and penetrating flash from the center of each mass of Nitro Glycerine exploded and giving a freer access for the oil or gas to develop the full rock pressure.

The natural result from a flash where the Nitro Glycerine is in an undivided state is for it to take the shape of a round ball as far as the conditions will allow, such a shot may be in a body, or strung out over a given number of feet and confined within a hard wall formation, which has a tendency to draw out its shape from a perfect ball to one as near perfect as the wall formation will allow, but in all conditions there is an extra, strong, narrow and far-reaching flash starting at a point of its greatest diameter and leading in any uncontrolled direction, and always with a tail flash in an exact opposite direction, with equal power and intensity. This occurs in all cases whether confined, or unconfined, above ground, or below, large or small quantities, but if these masses of Nitro Glycerine are spaced certain distances, according to the volume exploded, then the separate masses will all have a separate and distinct flash of its own, and most always in opposite directions. Shots in wells and explosions on top of the ground, do not often act the same, for the above reasons. Shots in wells sometimes cannot be heard or felt on one side of the well or rig, but in a direction at right angles from that point, it may be heard or felt long distances away. Many cases where men and horses are uninjured a few yards away from an explosion, houses were wrecked, or twisted long distances away in another direction.

The closer one gets to an explosion of Nitro Glycerine on top of the ground, and lives to tell it, meaning at a point just beyond the reach of the flash and at or near where the air not consumed has been violently

forced away by the concussion, the less liable one is to hear the explosion even when his ears are not affected, for the reason that he is standing, or lying in a vacuum in which case neither heat, cold nor sound can penetrate. The principal move to make, in case of a possible explosion, and where there is a chance, is not to try getting a long distance away, but from 100 to 200 feet and lie down flat with the face and mouth to the ground. Very few things fall within that distance, and the heat from the flashes always raise, and on an incline of about 10 feet rise in every 100 feet traveled.

The chances of casing in wells being damaged by the tail flash from an exploded shot rising straight up, or, on a short incline in an upward direction, can be greatly reduced by spacing the shells containing the Nitro Glycerine from 12 to 14 inches apart, which causes the explosion from each shell to have a separate and distinct flash of its own, and these of such varying direction that they counteract one another, besides the shot is better for the results wanted. The mass must be divided far enough to break the flash from becoming solid.

The results of shots in the propellant class gives an expansion of gases without the consuming flash, and in all cases, they continue to expand until they reach the point of least resistance and a sufficient outlet, plus a crumbling rack-a-rock effect on an oil or gas sand with the pressure on same in a wrong direction, which can never be overcome except in extreme

cases, and that where the natural rock pressure is great enough to partially counteract the above results and making a thorough cleaning out of the well an almost impossibility.

Nitro Glycerine has few uses except when used with an absorbent to slow up its combustion. Its main and important feature is its ability to be slowed up or its intensity increased by pressure for any purpose, in which case, it has no equal.

Where oil sands are highly saturated, shots containing as low as 36-100 of a quart to the foot, and exploded without other tamping than the very light oil the hole contains, are known to be injurious, at least not beneficial and in cases where the follow-up is strong enough to reach the surface of the ground, a very rank dose of burnt substance greatly resembling lamp black appears. Such sands should have water tamping at least for the length of the shot. Where this is ordinarily impossible, the small shells containing the nitro can be inserted in as large a shell containing water (salt water preferred) as can be safely placed at the proper spot for shooting. This apparently has the effect of tempering the burning power of the flashes to the desired degree. Jack-squibs should not be dropped on such shots but instead they should be made into time-jacks and lowered with wire, previously run with weight, and wire tabbed or marked, which case, insures the proper spooling of wire and lessens the chance of a fluke, while squib of that nature is being run through long strings of valuable

pipe. This is up to the producer to see that care equally as extensive is used while exploding such shots.

The number of quarts to the foot in any shot should be governed entirely by the richness or the barrenness of the sand being shot, all of which can be judged best by being on the job when the samples of sand are being washed out and their position carefully measured by the same steel line each time and the man in charge should not be above running said line and washing out samples, which procedure insures the safety of the line, uniform accuracy of measurements and raises him to a position where no one has a right to dictate over him as to what that particular well requires to complete the finishing touches. Dry samples of sand are as inaccurate for judging purposes as to compare with the proverbial boy being sent to mill. Likewise, cable measurements and frequent change of crews. Petty complaints on drilling crews and shooters, never adds anything beneficial to the well being worked upon.

Gas wells are at their best when the sand has been drilled and the mudded-up wall has had time to thoroughly clean itself. Shots are most successful in same, after the rock pressure has greatly decreased and then shot dry with about one quart to the foot for 5-inch hole, and under. With slight increase of shot for increased size of hole to be shot.

The thawing of Nitro Glycerine at the wells can be done reasonably safe or the reverse, according to the method used. Live steam in direct contact with a

can of Nitro Glycerine is about the most dangerous thing that can be done. To thaw rapidly, remove one or both corks from each can. Hang by ropes near top of barrel nearly filled with hot water. Heating can be done with steam and water brought up to near the boiling point on surface. Bottom will be much cooler. Cans must not be in, or close to the barrel while heating with steam. Loose pipe connections sometimes fly off besides making it possible for live steam to reach the cans. Thawing will be much quickened by keeping the thawed stock poured off the ice. Nitro Glycerine being a very poor conductor of heat, the thawed stock greatly hinders the ice within, from receiving the heat required. In all cases, remove the cork before thawing and see that the frozen stock does not completely cover the inside opening of the can nozzle. Frozen corks should be removed by first applying a little warm water, or warm ball of waste to can nozzle.

A full, or near full can of Nitro Glycerine should never be put out for transportation under any circumstances. A can properly filled with Nitro Glycerine and having the balance of space, filled up with water, carelessly or otherwise, is just as dangerous for each can must have ample room for expansion under all temperatures. For long hauls, nothing can be better than to remove about a pint of stock from each can to be hauled and carried in extra cans or poured out, and wasted, rather than take the extra risks.

Cone, or cork top shells should be handled the same as cans and for the same reasons, that is Nitro

Glycerine is sensitive in direct proportions to the pressure of confinement. From the fact that Nitro Glycerine qualities for expansion are so great in changing from frozen or to the thawed state it follows that the stock in a 2-inch 10-quart shell 10 feet in length will raise nine inches with any appreciable degree of increased heat, and with that shell corked tight or having too small an air hole it would make that shell a very hazardous undertaking to run through a long string of pipe and especially deep wells where the temperature is known to increase with depth, plus friction.

An easy and quick method to observe the rapid expansion and contraction of Nitro Glycerine is to place a drop of it on a thin piece of tin or copper, then heat a pan of water to near the boiling point, and take a ball of wool or other absorbent fastened to a stick, dip the wool in water, and raise and lower it near the underside of the tin. Then watch sample with magnifying glass, if handy. The action of the sample will be nearly as rapid as the hand carrying the absorbent. Nitro Glycerine reaches the bursting, or exploding point at a temperaturue of 360-F, and the heat from the above described experiment and in the open air would not be more than one-half the danger point.

For the benefit of those who claim that the flash, or force of dynamite is always down, even when lying in the open air and on a hard surface, I would say, that the initial point of expansion is always up, and the tail or opposite point is down, and therefore the only

part of said blow that can be recorded. (The writer does not claim or desire familiarity with the fine points of a dynamite plant, for the simple reason that there are too many Chinamen mentioned in the press dispatches as being among the list of killed and injured.)

In cutting collars of tubing and casing of all sizes, and especially, under fluid, nothing equals a line shot of just the required amount of Nitro Glycerine according to the size of pipe and amount of pressure given by the fluids, this to be thoroughly absorbed into dry sand of about 4 or 5 times the amount of Nitro Glycerine used. This small charge must be placed exactly within the collar to be cut, and not the length of the expanding wires, or squib below the collar. This charge when carefully handled will not damage more than the joint of pipe carrying the collar shot, and should not do more than split the threaded end. In cases where claims are made that the shots were repeated in same place and increased to 5 and even 10 quarts of pure Nitro Glycerine and then loosened the pipe, would say, that the only way this is at all likely, is where the first shots had opened the hole and extending outside of the pipe the balance of the shots were reaching up and outside of pipe to where casing was really fast, and thereby loosening the same. It is possible for the weight being dropped over small sand shots, to be deflected by pieces of wood, or other floating substances lying on top of the fluid, and causing weight to strike endwise in a nearby collar and thereby causing a bump which can easily be mistaken for the shot itself, and then afterwards get the real bump in

the wrong place. (Nothing impresses one more than the real experience.)

In defense of so-called high prices of Nitro Glycerine torpedoes exploded in wells seen for the first time by the shooter when called on to do the work. A few facts made plain, might assist the producer to write with a clearer frame of mind when using his check-book. Every time that nitrator at the factory is charged, there is 1725 pounds of mixed acids and glycerine oil used, and out of this charge there is 1225 pounds of it that goes down the acid ravine, and known as "dead waste." The demand for acids suitable for manufacturing Nitro Glycerine is so great that cases are not at all rare where freight on same is paid for distances of over 1,000 miles. For a better understanding of the value of glycerine oil, let any one interested, apply at a drug store. That experience is too common to need any comment. Again, the chances for finding places to manufacture Nitro Glycerine, that are suitable, or possible, are so rare as to compare favorably with like chances of making the Arkansas river navigable. These facts coupled with the extra hazards, plus the oversights on the part of the shell-makers, the haste asked for by the producer, and sometimes, necessary. This with the blinding storms through which shots are quite often transported and handled, with the object of saving the contractor or well owner large sums of money, are only a few of the reasons for the prices asked and too often, never received. For the good of all concerned, a dead-beat list kept and handled, same as merchants in all other lines, should be put in force immediately.

In answer to the frequent queries as to why the Nitro Glycerine of the present day is not as strong or good as the glycerine manufactured in the old Bradford days, would prefer to illustrate: The plug from acid drums and glycerine drums are for the most part, interchangeable. If plugs from acid drum is screwed into collar of oil drum, with the acids and oil left on their respective threads, there will be an immediate explosion, which goes to show that the mixture is too instantaneous for mechanical variation, and the only difference in the stock used today, is that it is more thoroughly washed, avoiding expansive gases on top of stock, and thereby, safer to handle.

This much has been given with all due respect for the different opinions caused by the different experiences of the fraternity. For the variation in methods used in manufacturing and handling of Nitro Glycerine are, for the most part, without number.

jakt net
2,50 80.