

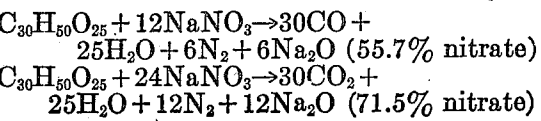
UNITED STATES PATENT OFFICE

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PROCESS OF IMPREGNATING PLANT TISSUES WITH SODIUM NITRATE FOR EXPLOSIVE PURPOSES

No Drawing. Application filed February 7, 1923. Serial No. 617,610.

The chief object of my invention is to bring sodium nitrate into closest physical contact with the cell walls of plant tissues effectively comminuted so that the materials are aggregated in alternate, minute and laminated masses. The effect of such structures in the materials is to bring about superior explosive properties, not possessed by mere mechanical mixtures of the same materials, as was revealed in the data set forth in my prior application filed Sept. 16, 1922, Serial No. 588,708. The superior properties obtainable are such as increased toughness and density of granules, greater susceptibility to combustion, greater effective explosive power, and lessened hygroscopy. The increased toughness and density of granules result largely from elimination of air from the plant tissues and from formation of laminated structures which prevent segregation of materials, and dead pressing of its masses. Greater certainty of combustion of all granules of the impregnated masses is promoted because, at the moment of explosive dispersion, substantially each particle is composed of both the combustible, plant tissue, and the oxidant, sodium nitrate. The sensitiveness of combustion and explosion is further promoted by the momentary confinement in the cellular structure of compressed gases and consequently the kindling temperature and the explosive wave are maintained. The susceptibility to combustion is superior to that of non-impregnated materials and approaches that of black gunpowder. This can be demonstrated by direct ignition and is important in that, without loss of explosibility, larger granulation is possible and consequently the progressiveness and the rate of detonation can be varied and controlled. In other words, the intimacy of contact of materials enhances the sensitiveness of combustion and explosion becomes complete in accordance with chemical reactions:



The comparative gas volumes, according to Mendeleeff's formula, of these compositions and of black powders, with varying percentages of nitrate used, are as follows:

|                                                                            | V <sub>1000</sub> | Per cent of nitrate |
|----------------------------------------------------------------------------|-------------------|---------------------|
| C <sub>30</sub> H <sub>50</sub> O <sub>25</sub> +12NaNO <sub>3</sub> ..... | 66.6              | 55.7                |
| C <sub>30</sub> H <sub>50</sub> O <sub>25</sub> +24NaNO <sub>3</sub> ..... | 47.0              | 71.6                |
| S+6C+2NaNO <sub>3</sub> .....                                              | 51.0              | 62.0                |
| S+3C+2NaNO <sub>3</sub> .....                                              | 33.6              | 71.4                |
| S+6C+2KNO <sub>3</sub> .....                                               | 45.7              | 66.0                |
| S+3C+2KNO <sub>3</sub> .....                                               | 29.6              | 74.8                |

Here it is observed that, other conditions remaining the same, cellulose gives greater gas volumes than charcoal and sulphur and requires less nitrate. That more explosive power can be obtained was demonstrated in the table given in the above mentioned prior application. Therein it was revealed that substantially one-third more power of demolition, as measured by the sand test, can be obtained with materials subjected to my process of impregnation, than with the same materials merely mingled mechanically and that this power is greater than that of the best black gunpowders. It was further demonstrated that a maximum of power was obtained with compositions containing 65% of sodium nitrate, or substantially midway between the compositions necessary to form CO and CO<sub>2</sub>, in accordance with the above mentioned chemical equations. However, it must be observed that useful compositions of lesser percentages of nitrate are available through my process. The utilizable large percentages of plant tissue, such as sawdust, and the low cost of sodium nitrate contribute to make these compositions the cheapest of present day explosives. A further great advantage of these powders is the capability for manufacture of different sizes of granules. A final advantage of this process of impregnation lies in the use of all varieties of sawdust, since resinous wood or bark are not prohibitive, except when nitro-glycerine is a component of the finished powder composition. Since this process is applicable to all types of comminuted plant tissue, it is to be understood

that sawdust, wood meal, wood pulp, etc., are interchangeably used to describe the application of this process. All of these plant tissues and physical modifications of the same, being susceptible to impregnation with soluble alkali nitrates, are obviously examples of my process.

To illustrate the details of my process, I can take two parts by weight of sodium nitrate and add to it one part by weight of water and heat until all of the salt has passed into solution and begins to form on the surface a scum of recrystallized nitrate. The boiling temperature of this hot saturated solution is now 120° C, and the percentage of water in the fluid portion is substantially 32. The effect of continued heating at 120° C. is to dissolve all lumps of nitrate from the bottom and to precipitate minute crystals of the same from the surface scum. The solution and sludge thus formed is treated with about one part by weight of dry comminuted vegetable tissue as, for example, sawdust. This treatment can be made either by adding sawdust to the hot nitrate mixture or by running the latter into the sawdust. Since there is hazard of combustion when the source of heat is continued and the mixture becomes dry locally, it is evident that the latter method will preferably be employed and for the further reason that such treatment enables one to use the flow method instead of the batch method for manufacture. In either case, when the mixing is complete the average temperature is about 110° C, the concentration of water is less than 25% and impregnation of all parts of the vegetable tissue with saturated solution of the nitrate is effected. When this hot mixture is now run through a screen or trommel, very important advantages are obtained over all methods of drying en masse. The contained sensible heat as well as the heat of crystallization cause rapid evaporation of water to a point below 10%, the granulated screened mass shows no tendency to cake and owing to their rapid formation, the crystals of nitrate contained therein are more minute and explosively effective than when similar mixtures are heated en masse so as to evaporate the water. Since solutions containing greater quantities of water than herein specified tend to run, to stick to the sieve or to cake in the sifted mass, heating to 120° C. until scum forms on the solution is the critical condition for successful impregnation, granulation and drying. By this improved process no grinding is required except for the original vegetable material for the mass thus separated is so granulated that the final drying can be effected without caking and without necessitating further grinding and screening. The final drying is effected by any of the

usual methods that can be applied so as not to develop dust. Advantageously this final drying will be effected at so low a temperature as can be made consistent with the speed of operation. Under favorable conditions air drying may be used.

The product thus obtained resembles in appearance very closely the original sawdust, except that it may be darker in color and may be observed to contain some powdered sodium nitrate. Under the microscope this impregnated material is observed to be made up of conglomerate masses of the two components, the sodium nitrate being present both extracellularly and intracellularly in respect to the cell walls. On the other hand, in mechanical mixtures of the two components, a condition of juxtaposition and extracellular aggregation only are observed. The cohesive intimacy of contact of the two materials in the impregnated masses, together with the uniformity and minuteness of the two components contained therein, are novel and contribute to the superior quality of the product of my process.

It was revealed in the prior application that the composition manufactured by the herein described process, though possessing the properties of sensitiveness of combustion and of potential superior power for explosive purposes, lacks certainty of detonation, that is, the impregnated mass will burn without exploding, except when powerfully confined and detonated. In other words, it was observed during its combustion that the sodium nitrate tended to melt and segregate, the explosive ware falling off rapidly, and the main charge usually continuing merely to burn. I have found that this objection can be overcome by incorporating with the impregnated masses certain small percentages of other materials which themselves are detonating, as for example, plant tissue impregnated with ammonium nitrate, or nitroglycerine, or the nitrotoluenes, or other nitro organic compounds. Thus, plant tissue impregnated with sodium nitrate can advantageously be the preponderating component of many useful explosive compositions. All of these compositions, involving as they do the herein disclosed process and the product thereof, are held to fall within the scope of my claims.

I claim:

1. The process of impregnating comminuted plant tissues with sodium nitrate for explosive purposes which comprises heating of said plant tissues with concentrated aqueous solutions of sodium nitrate at 110–120° C., screening the hot masses so that spontaneous evaporation of water may be promoted through the heats of the solution and of crystallization and finally drying the masses at low temperatures, substan-

tially without mechanical agitation so that formation of dust may be avoided.

2. The process of impregnating comminuted plant tissues with sodium nitrate for explosive purposes which comprises forming at 120° C. saturated aqueous solutions of 2-5 parts of sodium nitrate, removing the source of external heat and adding 1 part of said plant tissues in portions and at such a rate that the temperature of the solutions can be maintained at 110-120° C. and all of the said plant tissues have been wetted and impregnated with the hot concentrated solutions of sodium nitrate, finally screening the hot masses and drying at some lower temperature consistent with safety for avoiding formation of dust.

3. A process for the impregnation of vegetable material with a soluble salt to form an explosive, which comprises the obtaining of a mixture of substantially saturated aqueous solution of said salt and comminuted vegetable material in explosive proportion, maintaining the temperature of said mixture substantially at boiling point for a sufficient time to secure through impregnation of the vegetable material, and then screening the hot impregnated mass.

4. A process for the impregnation of vegetable material with a soluble salt to form an explosive, which comprises the obtaining of a mixture of a substantially saturated aqueous solution of an alkali metal nitrate and comminuted vegetable material in explosive proportion, maintaining the temperature of said mixture substantially at boiling point for a sufficient time to secure thorough impregnation of the vegetable material, and then screening the hot impregnated mass.

5. An explosive comprising particles of plant tissue impregnated with sodium nitrate, the quantity of sodium nitrate being at least 50% greater than that of the plant tissue, and a sensitizer the percentage of which is much less than that of the plant tissue.

In testimony that I claim the foregoing, I hereto set my hand, this 2nd day of February, 1923.

WILLIAM M. DEHN.