NITROGLYCERINE, GLYCERYL TRINITRATE

The common name Nitroglycerine is in fact a misnomer. Strictly speaking the prefix “nitro” can only be applied to molecules that contain the nitro group (NO_2). Glyceryl trinitrate contains the nitrate group ($O.NO_2$). Some examples of true nitrobodies are:

Nitrobenzene $C_6H_5.\mathbf{NO_2}$.

Nitromethane $CH_3.\mathbf{NO_2}$

Compare these with Glyceryl trinitrate $C_3H_5\mathbf{(NO_3)_3}$

Mind you, the name Nitroglycerine is so well entrenched that it is the name for the explosive throughout the world.

The Italian chemist Ascanio Sobrero discovered nitroglycerine around 1846/7. Originally used as a treatment for medical conditions. Its explosive qualities were well known even then so it was made in very small quantities. Much effort was put into manufacturing NG on a large scale but many accidents made the business somewhat dangerous. Research efforts by Alfred Nobel resulted in his discovery that the inert porous earth called “Kieselguhr” would make NG safer to handle than raw NG. Further research led him in 1875 to the discovery that soluble Nitrocellulose was “gelatinized” by NG. The explosive resulting from this mixture was called “Blasting Gelatine” The most violent of the commercial explosives.

This discovery led directly to the production of Ballistite then eventually the various cordites and all the other standard propellants in existence today. The discovery also created a demand for the new explosive which in turn placed huge requirements on the explosives factories.
Nitroglycerine is the most important explosive ingredient. It is the basis for most propellants and many explosives.

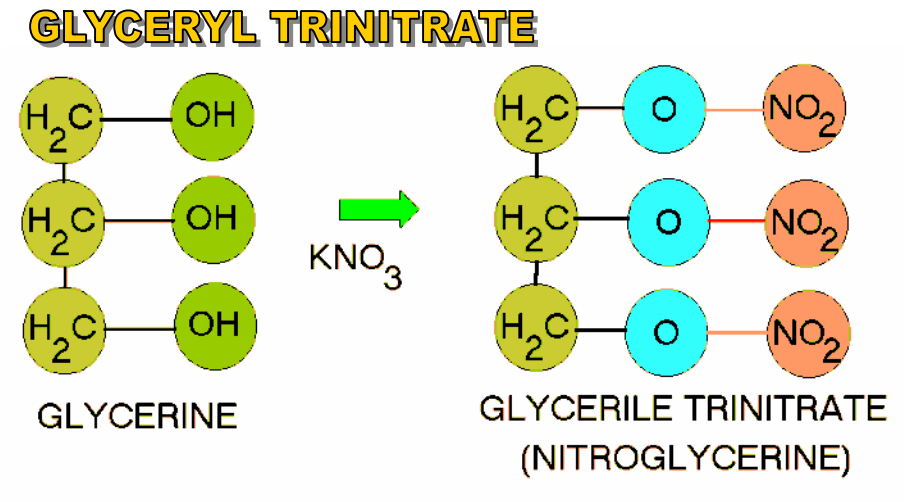
Its characteristics are:

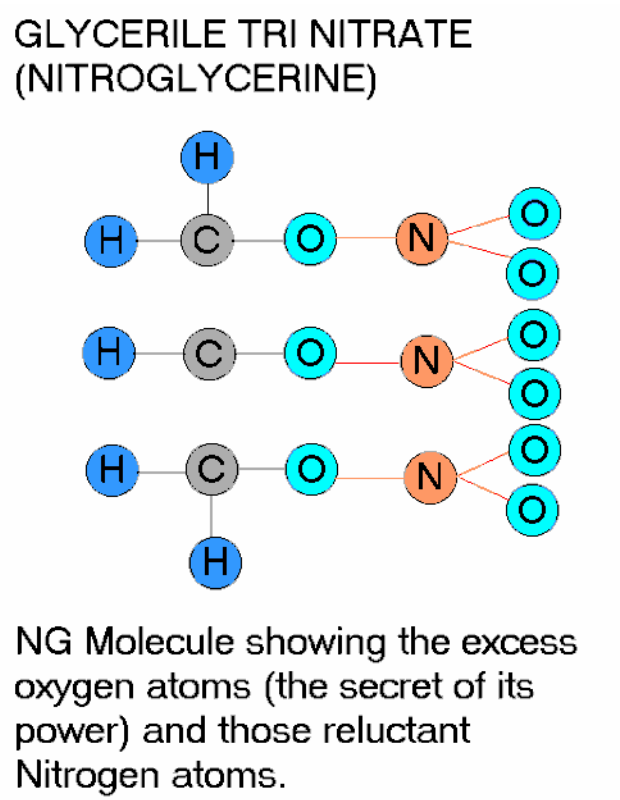
- IT IS A CLEAR, OILY LIQUID.
- JUST SOLUBLE IN WATER AND VERY SOLUBLE IN ORGANIC SOLVENTS.
- IT IS POISONOUS AND IS EASILY ABSORBED THROUGH THE SKIN, GIVING RISE TO VIOLENT HEADACHES DUE TO DILATION OF THE BLOOD VESSELS IN THE BRAIN.
- IT WILL DECOMPOSE BEFORE BOILING IF HEATED.
- IT WILL BURN QUIETLY IF IGNITED (NOT A SENSIBLE THING TO DO)

The physical properties of Nitroglycerine.

FORMULA	MP	IP	POWER	F of I	V of D	Density
$C_3H_5(ONO_2)_3$	decomposes	188^0	159	13	7500mps	1.6

When nitroglycerine detonates it does so in the following manner:
$4C_3H_5(NO_3)_3$ → $12CO_2 + 10H_2O + 6N_2 + \underline{\mathbf{O_2}}$ It is easy to see that there is a surplus of oxygen left over at the end of the reaction.

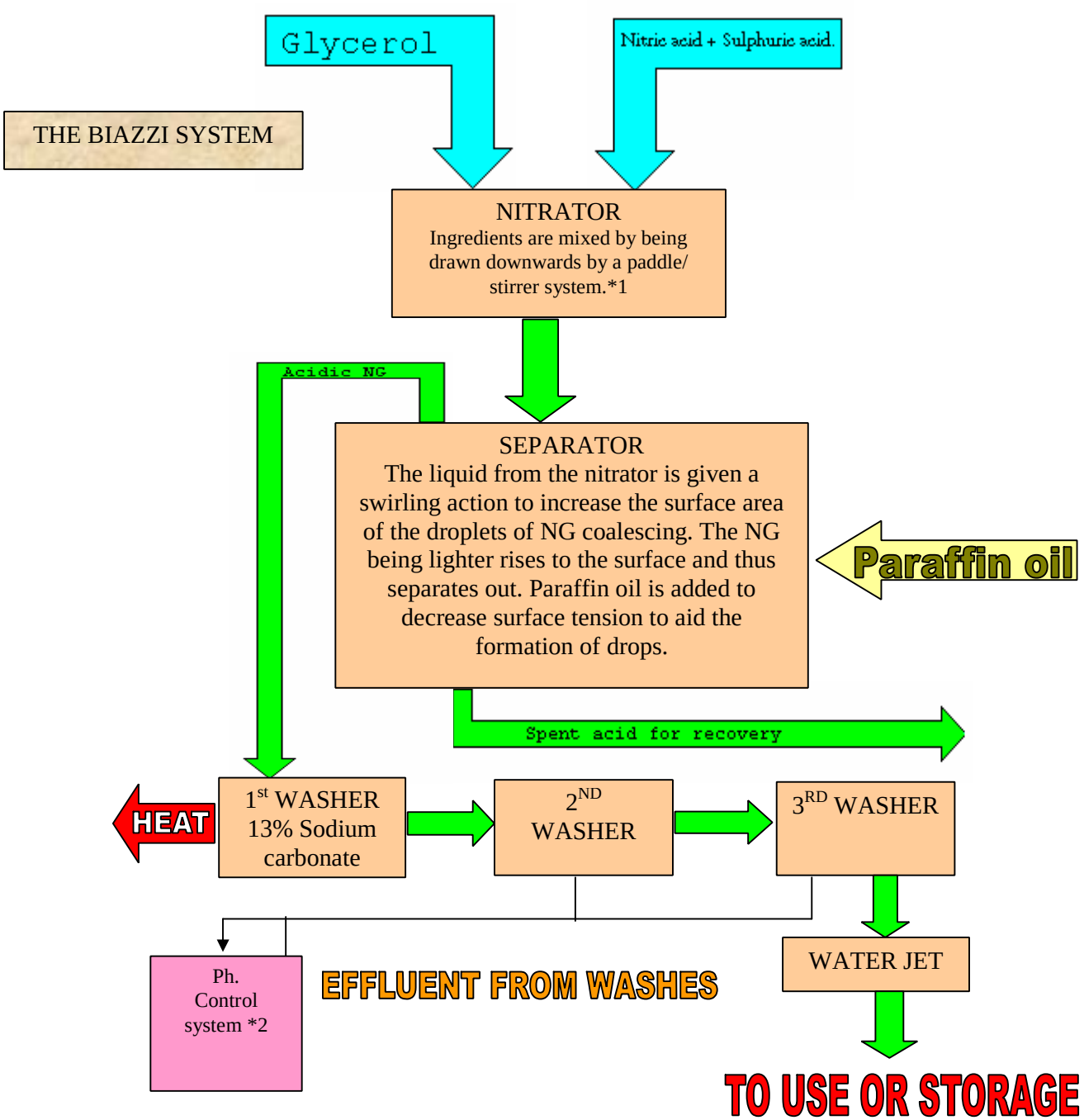




NG Molecule showing the excess oxygen atoms (the secret of its power) and those reluctant Nitrogen atoms.

MANUFACTURE OF NITROGLYCERINE

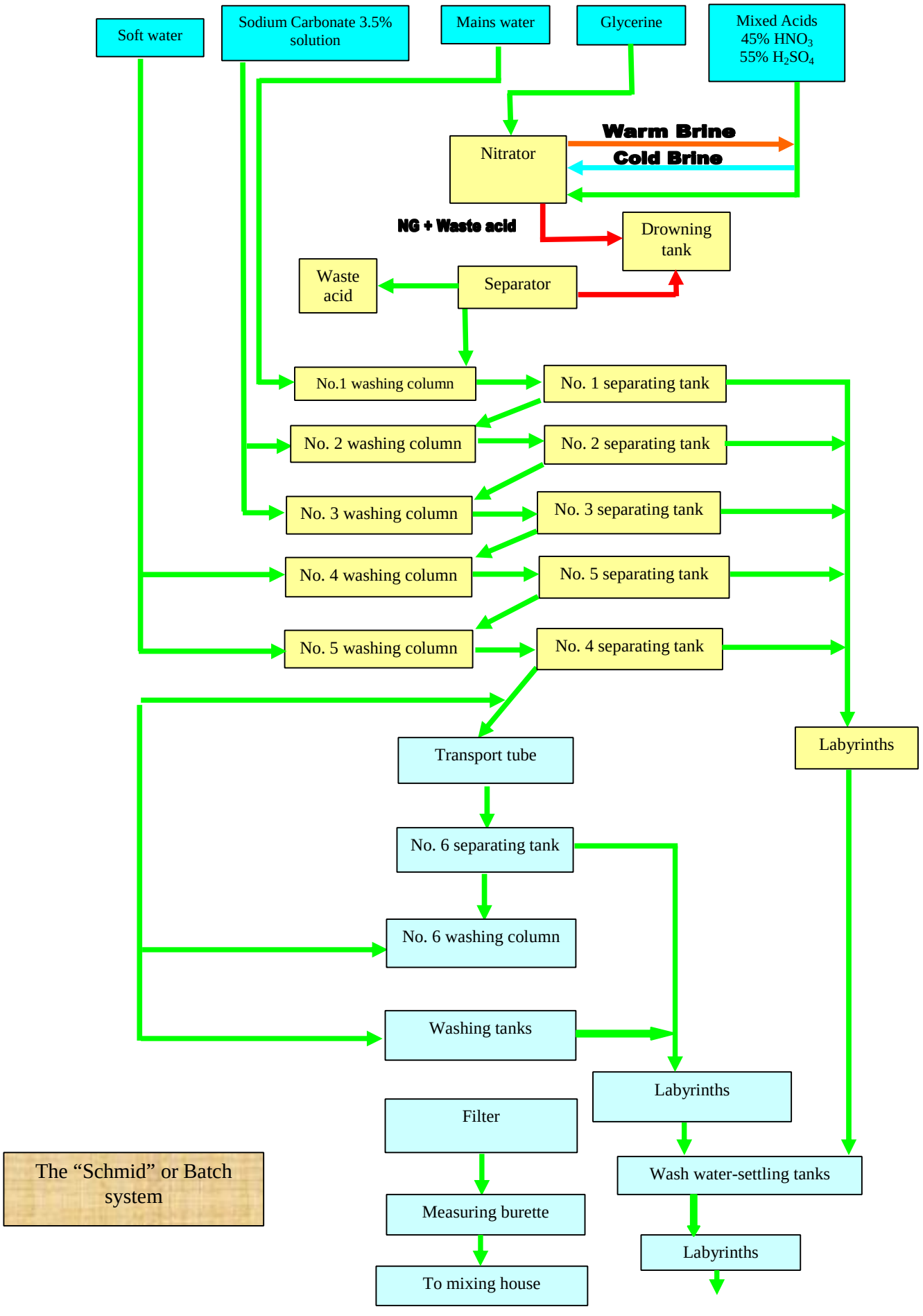
Originally NG was made in batches of up to 2600lbs of the explosive. This is an awful lot of NG to have in one place. This was achieved by mixing 2.5 tons of mixed acid with 1400 lbs of glycerol. Any accident with these quantities involved was always guaranteed to be a major accident. The chemical engineers were well aware of the drawbacks of the batch system and much effort was expended in producing a continuous process. A chemist by the name of A Schmidt developed a continuous process in 1927 that went a long way towards a safer NG production line. The smaller quantities for a start made the system less hazardous. A Swedish chemist by the name of M. Biazzi developed his version of a continuous process that very quickly became recognized as one of the best available. It is still in use in many factories today. Australia was using this system up until the late 70s.



NOTES ON THE MANUFACTURE OF NG.

1. The size and shape of the nitrator is such that the ingredients are kept in close proximity for the correct time to allow proper nitration. It is important for this time to be the minimum possible.
2. The Ph. monitoring system ensures that the consumption of sodium carbonate is reduced to a minimum by measuring the alkalinity of the effluent and adjusting the sodium carbonate levels as necessary.
3. Safety devices are in place that prevent any nitration operations being carried out until all the safety features are functioning and all preliminary steps have been taken.
4. During operations red blinking lamps, bells ringing and an illuminated inscription showing the cause of the alarm, signal any hazards occurring. The nitration process is stopped and cannot be restarted until the problem has been resolved.
5. Where actual danger arises from a problem or the temperature exceeds a certain level the whole system shuts down and the contents of all stages are dumped into water by means of bottom openings in each of the tanks.

The above system is a continuous process and as such, the quantity at any one time is reduced to the minimum possible. It was introduced to get away from the very dangerous "Batch" process. As you can imagine having a large batch of NG being moved around the factory, being worked on, being stored and all the other things making up the process gives rise to great danger. After all 2600 lbs of raw NG is a nasty beast to deal with. The chemical engineers introduced the continuous process to get away from the "Schmid" process, which is shown below.



The "Schmid" or Batch system