Ammonium Polysulfide Solution
20-0-0-40S

Nitro-Sul®

Application Guide

Tessenderlo KERLEY

PRODUCT ANALYSIS

Nitrogen (N) 20%
(20% Ammoniacal Nitrogen)
Combined Sulfur (S) 40%

Derived From: Ammonium Polysulfide

Density:

Density, lbs/gallon @ 68°F 9.4

What is Nitro-Sul®?

Nitro-Sul is a dark red solution containing 20% ammoniacal nitrogen (equivalent to about 24.5% anhydrous ammonia [NH_3] and 40% Sulfur as polysulfide. It weighs approximately 9.4 lbs. per gallon.

Nitro-Sul has the highest sulfur content of any chemically combined nitrogen-sulfur solution available to the fertilizer industry and the grower. The chemical formula may be represented by $(NH_4)_2S_x$. Nitro-Sul, the "original" sulfur solution, was developed by Kerley Chemical in 1951.

Why does Nitro-Sul contribute to a better crop?

1. Sulfur is a necessary plant food. Nitro-Sul is rich in fast acting sulfur. A leading agriculturist recently stated: "Sulfur fertilization is increasing yields of more crops on more soils each year. A few years ago sulfur fertilizers were recommended only in the western U.S. and in sandy soils in the more humid areas."

   Now sulfur responses have been demonstrated in many additional geographic areas. This rapid recognition of sulfur deficiencies may be attributed to: (a) accelerated depletion of soil sulfur reserves through crop removal, erosion and leaching losses, (b) greatly increased use of nitrogen fertilizer, (c) the shift to high analysis fertilizers, and (d) lowered atmospheric sulfur levels due to "Clean Air" legislation.

2. Plants digest nutrients after those nutrients have been made soluble by "digestive acids". Nitro-Sul not only provides important amounts of sulfur and nitrogen as plant nutrients, but the reactive form of sulfur in Nitro-Sul also provides a strong "digestive acid" helping the assimilation of needed nutrient elements such as phosphates, potassium, iron, zinc, manganese and calcium.

3. Irrigation water containing Nitro-Sul will penetrate much deeper into the root zone when applied to tight or so-called "slick" soils, and its effect in improving soil penetration may be noticed also in subsequent irrigations.

4. Subbing up across the beds in a field.

5. Applications of Nitro-Sul have a softening effect upon "tight" soils and such an effect may be evident by improved soil physical condition.

6. Nitro-Sul is a valuable source of nitrogen as it contains the non-leaching ammoniacal form of nitrogen.

7. Possibly the most important reason for using Nitro-Sul is revealed by the following quotation from the official publication of the California Agricultural Experiment Station, "California Agriculture", November 1958 issue, by W.E. Martin, in an article entitled, "Sulfur Deficiency Widespread."

   "Materials supplying sulfur alone may have no effect in cases of secondary sulfur deficiency unless nitrogen is also applied. A straight nitrogen material may give limited improvement with plants being a pale green."

   Nitro-Sul contains both of these important nutrients in chemical combination (not just a mixture) so that they remain together in combination upon deep penetration or when otherwise moved by soil moisture in the root zone.

KEEP OUT OF REACH OF CHILDREN • USE CAUTION WHEN HANDLING

PLANT FOOD AND EFFECT OF MINOR ELEMENTS

The outstanding results obtained from the use of Nitro-Sul is due to its high nitrogen and sulfur content. Nitro-Sul provides the beneficial action of sulfur in correcting alkali soils, as well as an oxidation reaction on unavailable plant nutrients such as phosphates, potassium, magnesium and minor elements in the soil. Nitro-Sul may make these nutrients available in sufficient quantities to supply the needs of the growing plant.

Sulfur serves as one of the important, essential plant nutrients and when applied to a sulfur-deficient soil, its use will result in increased crop yield and crop quality.

APPLICATION

Nitro-Sul, when properly handled, is easy and safe to apply. In irrigated areas it may be applied via the irrigation water. In the irrigation water, it will penetrate and give its beneficial action to the root zone. Or, Nitro-Sul may be injected in the soil just as done with other liquid fertilizers. General application rates may vary from 10 to 15 gallons per acre.

Nitro-Sul may be blended with other liquids such as water, anhydrous ammonia, aqua ammonia, urea solutions or UAN. Nitro-Sul may be blended in recommended proportions with other plant nutrient solutions to achieve the desired nitrogen-to-sulfur ratio to satisfy the needs of the crop. A recommended blend of UAN solution, 32-0-0 and Nitro-Sul, would result in a 29-0-0-10S analysis.

The amount of Nitro-Sul required per acre or hectare may vary due to soil conditions and crop requirements. Rates may vary dependent on whether Nitro-Sul is to be used to correct soil alkalinity, solubilizing other plant nutrients or supplying nitrogen-sulfur as needed plant nutrients. Crop response may be from a combination of the above. Where soils are sulfur deficient, most crops will exhibit a good response with the application of 10 to 25 pounds of sulfur. In some cases, forty pounds per acre per year of sulfur may be required, dependent on soil testing recommendations. In other cases, it may take several years of such applications before a visual difference in crop quality may be noted. It has been found that certain crops exhibit good response with one pre-plant application. However, good responses have been obtained from a number of smaller "spoon feeding" applications.

EQUIPMENT

Standard injection applicators are satisfactory for the application of Nitro-Sul. Equipment should not be left standing for prolonged periods after using a Nitro-Sul blend without first flushing and cleaning out the equipment.

Nitro-Sul may be stored in mild steel, fiberglass, polyolefin and stainless steel containers. It is recommended that Nitro-Sul storage tanks have a 2-4" layer of non-petroleum base oils, such as crop oil, soy bean oil or cotton seed oil, on top of the solution. This will help seal the ammonia vapors contained in the tank and will help in eliminating sulfur fall out.

As with all fertilizers containing nitrogen, brass and other copper alloys must not be used in contact with Nitro-Sul due to excessive corrosion.

MIXING WITH AQUA AMMONIA

Nitro-Sul may be mixed with 20% N Aqua Ammonia in any proportion. Vapor escapes should not be allowed, as it not only represents a loss of nutrients, but allows the formation of crystals which will precipitate out. *For long term storage, especially at low temperatures, Nitro-Sul should be diluted with Aqua Ammonia (at least one gallon of Aqua for every three gallons of Nitro-Sul).*

How does Nitro-Sul add Up ?

1. Safe and easy to apply.
2. Safe and easy to store.
3. Excellent source of nitrogen and sulfur.
4. Profitable and economical to use.
5. May be applied: pre-plant, water run or soil injected.
6. Increases subbing up of soil moisture.
7. Increases water penetration in the soil.
8. The best soil amendment and sulfur source in the market today!
9. Nitro-Sul has the ability to displace more Sodium (Na) than any other product currently available.

STORING AND HANDLING NITRO-SUL® (NH4)2Sx

Nitro-Sul contains 20% nitrogen in the ammonium form and 40% elemental sulfur as polysulfide. Nitro-Sul remains stable as long as this ratio exists. Nitro-Sul, if not adequately contained may lose ammonia causing the precipitation of sulfur in the bottom of the tank. Listed below are several steps to eliminate this problem.

1. Nitro-Sul is affected by heat. As temperature increases the vapor pressure increases proportionately causing a loss of ammonia. Painting tanks white to increase the reflectance will reduce the heat build up, thus reducing the amount of ammonia lost to the atmosphere.

2. Plumbing from the storage tank to the load out should be kept at a minimum length and painted white to reduce heat build up. A flush-out system should be plumbed into the load-out line so that product may be flushed from the line (use water or aqua ammonia) at the end of the day.

3. If material is left in the plumbing for a prolonged period of time with hoses capped or valves closed, pump seals may be damaged due to hydrostatic pressure.

4. Do not flush material back into the tank as this could cause dilution of material in the storage tank.

5. Use a non-petroleum based oil such as cotton seed, soybean oil or crop oil, on the surface of the product to prevent air contact. The non-petroleum based layer should be 2-4 inches thick and will provide protection for one season. In cooler climates, tanks should be cleaned out, if possible, in the fall before the winter season.

6. A U-vent should be used on storage tanks to reduce the amount of ammonia loss. Wind blowing across a straight vent will slightly reduce the atmospheric pressure in the tank increasing the likely hood of ammonia loss from the product. A U-Vent will help prevent this from happening.

7. Use teflon tape on all threaded pipe fittings.

8. Use a 3-5% hydrogen peroxide solution (medicinal strength) to spray on minor spills for odor control.

DO NOT

1. Do not leave straight-up vents or manholes open.
2. Do not leave hoses open to air unless they have been rinsed.
3. Do not mix with acids or other non-compatible products.
4. Do not let nitrogen fall below 19%

TRANSPORTATION

When dispatching trucks to transport a load of Nitro-Sul, request clean trucks. *Nitro-Sul does not mix with other liquid fertilizer products, such as 10-34-0, potassium containing products, or micronutrients.*

Customer Nitro-Sul Facility Check List

1. Are the storage tanks a light color?
2. What type of Nitro-Sul storage? Aluminum, Stainless steel, Carbon steel, Fiberglass, Poly?
3. Is the Nitro-Sul storage properly vented?
4. Does the Nitro-Sul storage have a light non-petroleum oil floating as a buffer?
5. Are the hoses for loading out the field equipment capped?
6. Is the storage tank plumbing hooked up separate from any other product to avoid contamination with the Nitro-Sul?
7. Are the Nitro-Sul, Aqua Ammonia, and NH3 field equipment in good condition?
8. Does the customer pump unused Nitro-Sul and/or Aqua-Ammonia back into the main storage tank?

9. Does the customer have check valves on the field tanks to keep other products from coming in contact with the Nitro-Sul?
10. Is the Nitro-Sul storage tank set up so that is a spill does occur, there is sufficient containment to contain the product?

PRECAUTIONARY STATEMENTS (Handling)

Avoid contact with the eyes. Chemical goggles and a full face shield must be worn. Avoid contact with the skin. Wear appropriate protective equipment to protect the skin, such as rubber or plastic aprons, gloves and boots. May cause serious gastro-intestinal distress if swallowed.

STATEMENT OF PRACTICAL TREATMENT

Eye Contact: Immediately flush with large quantities of water for 15 minutes. Hold eyelids apart during irrigation to ensure thorough flushing of the entire area of the eye and lid with water. Obtain immediate medical attention.

Ingestion: Do not induce vomiting. If victim is conscious, immediately give large quantities of water. If vomiting does occur, repeat fluid administration. Obtain immediate medical attention.

Skin Contact: Immediately flush with large quantities of water. Remove contaminated clothing under shower. Obtain immediate medical attention.

Inhalation: Wear protective respiratory equipment while removing victim from contaminated area. If breathing is labored, administer oxygen. If breathing has ceased, clear airway and start mouth-to-mouth resuscitation. Obtain immediate medical attention.

ENVIRONMENTAL HAZARDS

Keep out of lakes, ponds, rivers, and streams. Do not contaminate ground water or surface water by cleaning equipment or disposal of waste.

STORAGE AND DISPOSAL – Do not contaminate water, food, or feed by storage or disposal. Dilutions with water or UN32 should not be stored for more than 2 days. Do not store near acids or other acidic material.

GENERAL APPLICATION AND USE RECOMMENDATIONS

SOIL INJECTION

Nitro-Sul is an excellent source of sulfur for plant nutrition and soil amendment. Nitro-Sul may be injected into the soil in combination with anhydrous ammonia, UN32, and aqua ammonia to meet the sulfur requirements of a crop. Each gallon contains 3.8 pounds of Sulfur. Application rates are dependent on the crop, soil type, and placement. For best results, follow university guidelines for sulfur nutrition on crops for your area and soil test recommendations.

FLOOD AND FURROW IRRIGATION

Consideration should be given to the amount of nitrogen in Nitro-Sul and timing of applications. Each gallon of Nitro-Sul contains 1.9 pounds of nitrogen readily available to the crop.

Best Management Practices applications should be made so the crop may utilize the available nitrogen, either just before planting and/or during the growing season. To improve water penetration and remove salts on heavy clay soils, the maximum recommended rate is normally required.

Alfalfa: Germination water – apply 5 gallons per acre to reduce salts in the seed zone. After cutting, apply 10 to 15 gallons per acre before regrowth has resumed.

Row crops and vegetable crops:

Pre-plant irrigation – apply 10 to 20 gallons per acre in the irrigation water.

At planting – apply 5 to 15 gallons per acre in the first irrigation to improve subbing across the beds. During the growing season – apply 5 to 15 gallons per acre per treatment.

Trees and vines: Apply 10 to 20 gallons per acre per treatment during the growing season to improve water penetration and reduce salts. Apply when the crop can best utilize nitrogen. Fall treatment – apply Nitro-Sul after harvest (before dormancy). Nitro-Sul provides nitrogen for next seasons early growth, enhances water penetration in dry, compacted soils and with the help of winter rains improves the leaching of salts.

GENERAL INFORMATION

Nitro-Sul is a dark red liquid containing 20% nitrogen in the ammoniacal form and 40% elemental sulfur. The sulfur particles in Nitro-Sul are between 0.4 and 0.002 microns in diameter. This small size allows the bacteria in the soil to quickly oxidize the sulfur to sulfuric acid, generally within 2 to 3 weeks under normal field conditions.

Nitro-Sul works in several different ways:

1) Conditions the soil
2) "Stretches" water by reducing salts
3) Improves water penetration
4) Reduces surface crusting in salt affected soils
5) Increase nutrient response, directly and indirectly
6) Makes available greater quantities of phosphate and micronutrients that have become "tied up" due to high level of $CaCO_3$ in the soil
7) An excellent source of nitrogen and sulfur, essential plant nutrients

The generally accepted formula for oxidation of sulfur in soils is:

$$S + 1.5\ O_2 + H_2O \ \leftarrow\rightarrow\ H_2SO_4 \text{ (Sulfuric acid)}$$

The following chemical equation shows the generally accepted manner in which H_2SO_4 reacts in alkali soil for exchangeable sodium replacement:

$$H_2SO_4 + CaCO_3 \leftarrow\rightarrow CaSO_4 + CO_2 + H_2O$$
$$CaSO_4 + 2\ NaX \leftarrow\rightarrow CaX_2 + Na_2SO_4$$

The sulfate ion neutralizes the charge of the sodium ions by forming sodium sulfate. Irrigation water can now leach the sodium below the root zone.

Under some conditions, such as injecting through irrigation systems, Nitro-Sul may replace considerably more sodium than some other soil amendments.

The following chemical equation shows the manner in which Nitro-Sul sulfur reacts in alkali soil for exchangeable sodium replacement:

$$S + 1.5\ O_2 + H_2O \leftarrow\rightarrow H_2SO_4$$
$$H_2SO_4 + 2\ CaCO_3 \leftarrow\rightarrow CaSO_4 + Ca(HCO_3)_2$$
$$CaSO_4 + 2\ NaX \leftarrow\rightarrow CaX_2 + Na_2SO_4$$
$$Ca(HCO_3)_2 + 2\ NaX \leftarrow\rightarrow CaX_2 + 2\ NaHCO_3$$

With Nitro-Sul, $Ca(HCO_3)_2$ as well as $CaSO_4$ may be available for reaction with exchangeable sodium. The oxidation of ammonium to nitrate produces H+ ions that would also be available to replace even more sodium than shown.

CAUTION (APPLICATION)

Injecting Nitro-Sul into drip or sprinkler systems is NOT recommended due to possible plugging.

Clean equipment after use.

DO NOT apply Nitro-Sul directly on germinating seeds or to foliage of plants. Nitro-Sul may damage germination and/or burn foliage.

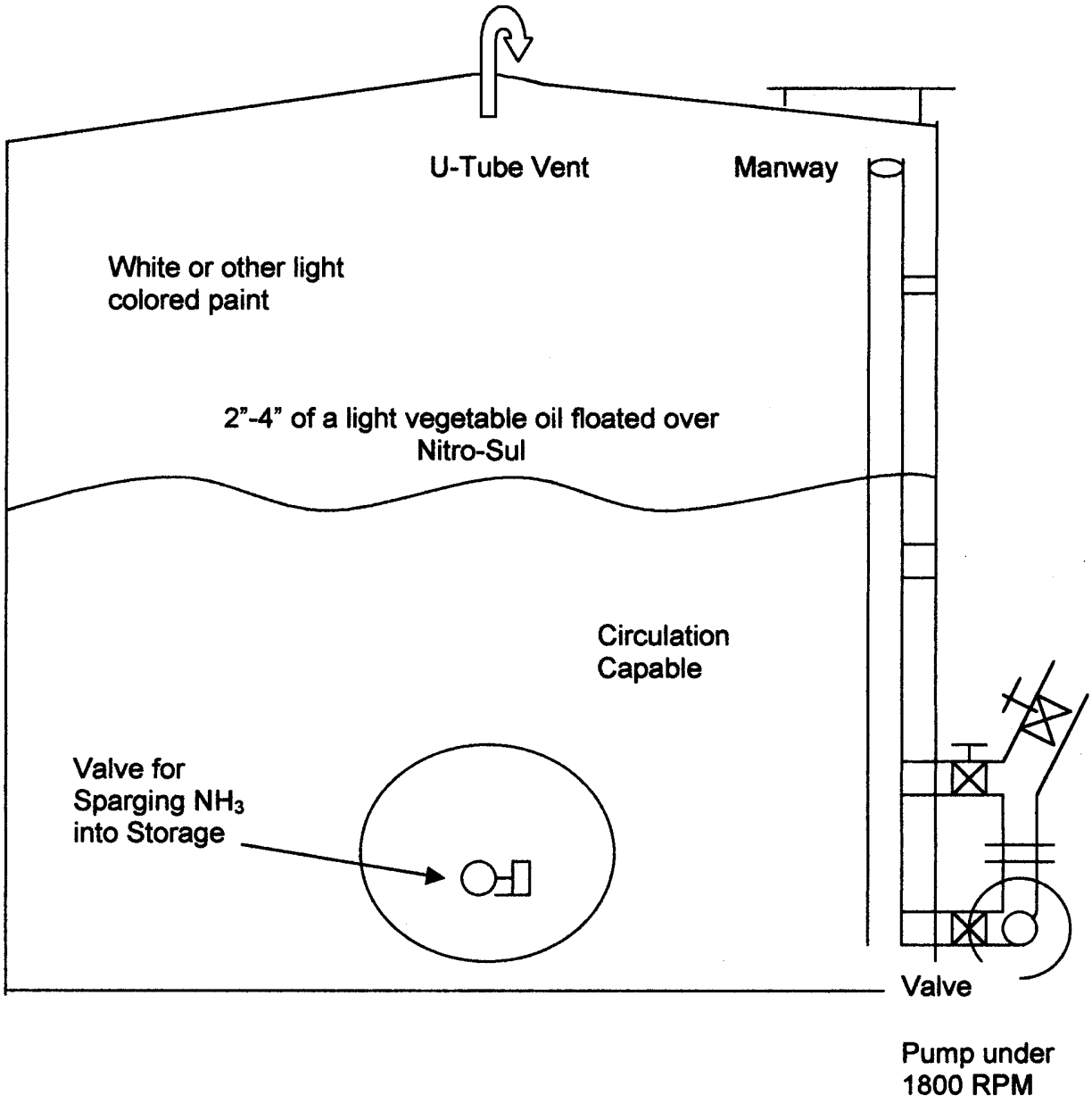
DO NOT use **BRASS** and **COPPER** containing alloys in fittings or nozzles when handling Nitro-Sul.

CAUTION (MIXING)

Do Not mix with acids or other acidic material, the resulting reaction may produce toxic hydrogen sulfide.

THIS IS A SOIL TREATMENT AND NOT A FOLIAR FERTILIZER.
FAILURE TO FOLLOW ALL GUIDELINES CAN RESULT IN CROP DAMAGE.

Nitro-Sul Storage Drawing



Nitro-Sul is a registered trademarks of Tessenderlo Kerley, Inc. USA

P.O.Box 15627 • Phoenix, Arizona 85060 U.S.A.
602-889-8300 • 800-525-2803
e-mail: info@tkinet.com • website: www.tkinet.com