

MANURE APPLICATION WITH A DRAGHOSE

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Draghoses are an alternative manure application system that have some important advantages for farms with a large amount of manure to spread. This system allows manure to be spread and incorporated with an irrigation pump. The pump sends the manure to a tractor through a flexible hose. The tractor pulls the hose and a tillage implement that immediately incorporates the manure.

FAST

Using an irrigation pump without the need to develop pressure at the outlet end allows more flow per minute than in a traveling gun system. The flow rates vary depending on the pump, the flowability of the manure, the size, type and length of pipe and any elevation differences. Typical flow rates vary from 400 gallons per minute to 1000 gallons per minute. Depending on the method used up to 40 acres can be spread before changing the setup of pipes to a new site. Reels to wind up the draghose can facilitate the change to a new site. The draghose system is a fast way to apply manure.

FLEXIBLE

The operator of the tractor determines how much is applied and where it is applied. The amount applied is varied by changing the speed of the tractor. A flow meter (\$5,700) would make an accurate determination of the rate easier to obtain, but calculations of the area covered and the amount removed from storage can be made. The flexibility of application rates and the ability to place the manure accurately along irregular field edges is an advantage of this system. The need for the operators constant presence driving the tractor assures that the manure goes where it is intended.

FRUGAL

There are many variables in determining the cost of applying manure. The total amount to be spread and the distance from the storage to the field vary from farm to farm. Costs will typically vary from \$.01 per gallon to \$.005 per gallon for draghose systems. This is comparable to other manure handling systems. The equipment needed includes an irrigation pump with engine (\$11,000), piping to the field (\$3.00-8.00 per foot), 660 feet of draghose (\$15.00 per foot) and a manifold (\$2,000) to be mounted on a tillage implement. Either a hard hose irrigation reel (\$30,000) to retract the draghose or another draghose and a tractor to extend the draghose will be needed. If using extension hose, a cart will be needed to wind the hose up. A cart can range from \$6000 for a self made cart to \$18,000 for a new cart. A hydraulic drive is necessary for winding the hose onto the cart. There is a cost to manure spreading but the draghose system is one of the lower cost methods for larger farms.

FEW ODORS

By incorporating the manure immediately into the soil, existing odoriferous compounds are tied up on soil particles. Most manure is not exposed to the air to prevent the transfer of odor to the air. The aerated condition of the soil with the manure properly incorporated encourages aerobic breakdown of the manure with little odor produced. This is one of the main advantages of this system. Odor control is becoming more and more important since storage of manure for timely spreading causes more odors while non-farm rural residents and their complaints are becoming more common.

FERTILIZER VALUE

Ammonia nitrogen is retained by immediate incorporation of the manure. This can be a significant increase in the amount of nitrogen available for plant growth, since the ammonium portion of the manure is lost if it is not incorporated. Losses start immediately for manure spread on the surface. It is estimated that 35% of the ammonia is lost with incorporation within the same day of application. If the manure application rate selected is used to meet the nitrogen needs of the crop, draghose incorporation will reduce the required application rate by up to 50%. This can be a disadvantage if the farm is trying to dispose of nitrogen. For farms with an adequate land base retaining the ammonium nitrogen will be an advantage since it will allow the manure to meet the nitrogen needs of more crop acreage and slow the build up of phosphorus and potassium by spreading the manure thinner.

LESS COMPACTION

Using the draghose to deliver the manure within the field eliminates the need to carry the weight of the manure across the field. Compaction from tank spreaders or injectors can reduce crop yields. Moisture condition of the soil must be adequate for the tillage operation used to incorporate the manure, but spreading manure on wetter soils can add to the losses to the environment by runoff and leaching.

EVEN APPLICATION

Wind drift and problems determining the amount of overlap needed are eliminated since the incorporation operation leaves a specific path that manure was applied to. Splash plates used by some of the incorporating implements rarely plug and provide an even application. Application is low to the ground so the wind does not affect it.

TILLAGE COMPLETED

The tillage operation to incorporate or inject the manure may be a benefit in preparing the ground. Chisel plows, shallow chisel plows with sweeps and disks have been used to incorporate or inject the manure and prepare the ground for planting simultaneously. An aerator for hay ground has been used to improve the tilth while assisting in the infiltration of manure slurry applied with a draghose after cuttings of hay. This is not as good at incorporating the manure or controlling the odors as the more traditional tillage implements but it does help.

DISADVANTAGES

The need for new equipment not readily available locally is one reason this technology has not been adopted since its inception in the '70's. There are two major suppliers of draghose systems:

Liquid Waste Technology	and	Hydro Engineering
Box 250		115 East Main Street
422 Main Street		Young America, Minnesota 55397
Somerset, Wisconsin 54025		612-467-3100
1-800-243-1406		

Another disadvantage is that the tillage operation may not match the soil conservation objectives of the farm and applying manure to a growing crop can't be done since the draghose will crush the plants. Some of the implements have been successful at retaining residue and even leaving a growing cover crop after the manure was injected.

There needs to be a sharp operator running the tractor and injection system. The individual really has to know what they are doing, or a liquidy mess can result. This is apt to be someone that you pay more. Someone with a good sense of responsibility.

There needs to be a relatively contiguous land base. You need to be able to reach fields from the storage. There may be problems if you need to cross a major road or someone else's property. Some have driven pipe underneath roads and hooked up as needed. Right of ways can be obtained to cross properties if burying pipe. Highway departments should prefer to give a pipeline right of way over maintaining roads with heavy manure spreader traffic. These are challenges that must be considered.

SYSTEM COMPONENTS

Separation The fewer solids in a pumped system the better it will work. There will be less friction loss to slow the flows and fewer opportunities for plugging. If the separated solids can be used for bedding or sold off the farm an additional benefit would be the improved operation of a draghose system. These systems should handle any manure that is pumpable. Although manures vary, dry matter contents up to 8-10% are workable. Wetter is better. The liquids from separation systems are typically 6% or less.

Storage Liquid manure stored in earthen waste storage ponds work well with the draghose system. The extra liquid from the precipitation on the pond is easily moved by a pump and pipe network. Earthen storage is the least expensive containment system. Care should be taken to properly document and design the storage. Satellite waste storage ponds located to avoid roads, yet centrally located near the fields they will supply manure to, would keep piping distances short to increase the flow rate and then the time it takes to apply the manure.

Pumps A pump designed specifically for manure should be selected. Unless the manure has been run through a separator a chopper in front of or as part of the pump is required. An open impeller will clog less and pass larger solids. The pump should have safety switches that shut it down in emergencies such as low oil pressure, high temperature and loss of head. Pressure gauges may soon plug with manure so be careful relying on them for information. For

most applications an engine hooked directly to the pump eliminating PTO gears will provide cheaper power. PTO's are not made to run uninterrupted for long periods under high loads. Pumps are rated for the amount of horsepower needed at a particular rpm for a specific flow at a given head. Different size pumps are more efficient in certain conditions than others. The pump manufacturer should be utilized to select the most efficient pump for a specific site. Two pump manufacturers are:

Cornell Pump
2323 SE Harvester Drive
Portland, Oregon 97222
503-653-0338

and Gorman-Rupp Company
PO. Box 1217
Mansfield, Ohio 44901
419-755-1011

Pipes Temporary aluminum pipe can be used to connect the storage to the draghose system and then moved to another site. The cost of this pipe varies with the price of aluminum. Used irrigation pipe is sometimes available (\$2-8 per foot). Temporary pipe run above the ground can be run over, shot, sabotaged or be poorly connected causing spills. It is easier to unplug than buried pipe but moving it after manure has been in it is a sloppy chore unless the line is flushed with clean water or blown clean with a pig sent through the line by an air compressor before it is disconnected.

Plastic pipes can be purchased and buried for about \$3.00 per foot. Buried pipes installed correctly should last a lifetime. The pipes need thrust blocks to prevent water hammer from separating the joints at bends. The pipes should be buried below frost depth to prevent freezing. Risers placed strategically can provide access for application along the line. Although the bigger the pipe the less the friction loss, a 6 inch diameter plastic pipe will not create too large of a head loss under most flow rates.

Six-inch extension hose is an alternative to pipe. This hose costs between \$7 and \$8 per foot. Hoses are made at 1/8 mile lengths. Shorter hoses, called remnants, can also be obtained at a slightly lower cost. Connection ends for the extension hose can cost \$200 per hose. This hose is wound up on a cart after use, and can be laid out by simply driving the route to the field. The advantage with this type of hose is that it eliminates burying pipe, and is less labor to lay out than aluminum pipe. Hose is typically cleaned out with compressed air forcing a ball through from one end to the other.

Draghose The draghose has been used commercially to inject sludge since the '60's. Agricultural applications began in the late '70's. The hose is manufactured by the same companies that supply fire hose and irrigation hose. The hose used in manure or sludge application is specifically made heavier for the abuse it will take. The hose is constructed of an ultra-violet resistant polyurethane cover and lining with a synthetic fiber core. The outside resists abrasion yet more sharp stones in the fields will wear it out faster. The life of the hose is estimated to be 75 to 100 million gallons with a 12 foot pass. The inside is coated to provide a lower friction loss. The friction loss can be estimated, but is hard to determine exactly because of the many variables involved. For instance the friction loss is estimated to be 27 psi per 660 feet for an 4.5 inch diameter hose operated at 100 psi and delivering 800 gallons of water per minute. The hose expands slightly with increased pressure so the diameter can vary. Manure at higher viscosities will increase the friction loss. The woven synthetic fiber provides the tensile strength for the hose. A tensile strength of 40,000 pounds is typical. Two sources for the hose are:

pressure relief valve directs the manure back into the storage when the shutoff valve is closed. This allows the soft hoses to stay hard to avoid kinking and twisting them as they are pulled around corners and across the field. The hydraulic shutoff valve costs about \$500 and the pressure relief valve costs around \$625.

Calibration A flow meter for this system costs \$5,700 so for most applications a calculation is made to estimate the amount the storage is lowered in a given operating time to determine the average flow rate. Pressure gauges plug easily with manure. Some gauges have an oil filled tube to keep the manure away from the gauge. They can plug also. It is hard to determine exactly what is going on in a manure transfer system with out instruments that can stand the environment.

Problems The flexible hose doesn't plug easily. With a chopper pump or a separator ahead of the pipe the solids left in the system move through the pipe pretty well. The nozzles and the manifold can plug. Keeping the same diameter through the distribution tubes helps to prevent plugging. When injecting the implement should be raised occasionally to be sure one of the distribution lines is not plugged.

The hose can be easily repaired with a steel sleeve inserted in the two hose ends and clamps tightened around each end. Pump problems can be minimized by installing shutoff switches and instrumentation that shuts the engine down for loss of pressure, high temperature and low oil pressure.

A plan to handle manure spills from pipe breaks or other emergencies should be available to all employees. The plan should include who to call to push up temporary dikes, to report a problem to the environmental agency, and to wash off or clean roads.

Nutrient Management Because incorporation and injection retains the nitrogen in the soil the amount of manure needed to meet the nitrogen needs of the crop is less than conventional spreading methods. A nutrient management plan with soil tests and manure tests is needed to avoid overloading the soil. Pre Sidedress Nitrogen Tests (PSNT) should be used to determine the carry over of nitrogen from fall applications. Fall applications are subject to both denitrification and leaching losses. Nitrate testing of the ground water as a precaution is recommended. Spring incorporation is environmentally and agronomically the best option. On farm ammonia test kits are available to determine the amount of ammonia nitrogen in the manure as it is being applied.