

DRAFT

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INSTRUCTION MANUAL UTILIZING POLYMERS FOR SEALING CANALS AND PONDS SAVING WATER

Voot

I. INTRODUCTION:

The information dispensed in this manual is based upon years of successful simulated testing and actual field test results using polymers. This manual is meant to serve as a guide to the various methods and polymers that can be used for sealing earthen canals and ponds. The critical points to consider are:

1. proper amount of polymer required for effective sealing
2. rates and concentrations
3. proper equipment to use
4. proper mixing of the polymers with water

Polymers can be a very cost effective short term or long term solution to sealing canals and ponds.

II. POLYMERS:

There are two main polymers used. Both are polyacrylamides, or PAM, for short and come in dry granular form. There are both potassium and sodium based polymers available depending on the manufacturer and either one is acceptable for use in sealing. PAM's are manufactured to strict standards and have gone through in-depth ecotoxicological testing. We recommend using a polymer that meets the residual polymer standard of 0.05%. Both PAM's are affected by temperature and will work faster in warm water (temp range) and much slower in cold water (temp range).

The primary PAM used in sealing is the single strand, or linear polymer. It also comes in a liquid formulation with up to 50% active ingredient. The granular forms are 90% active ingredient. The linear PAM does not absorb water, but is water soluble and acts as a flocculent, which means that in moving water it develops a negative charge and attracts positively-charged sediment present in the water. The sediment attaches to the PAM molecule. As it accumulates more sediment, it becomes heavy, falls to the bottom and forms a seal. This PAM is also used in erosion control for irrigation and treating municipal water supplies. The amount used for erosion control is very small and increases water infiltration into the soil, but when used in much larger concentrations it creates a very effective seal and prevents infiltration as described above. The rate of linear PAM to use is based upon the soil type being sealed, with clay soil using the smallest rate and porous sandy soil requiring heavier concentrations.

The second PAM is a cross-linked, or hydrogel, polymer and does absorb water. Crosslinked PAM comes in different grain sizes which dictates the size of the hydrated PAM. This PAM is also used in baby diapers to absorb and retain moisture. It is used in conjunction with the linear PAM for sealing when required. After application of the crosslinked PAM, it is held in place by spraying liquid linear PAM over it. The crosslinked PAM can also be used to fill holes in difficult to seal areas due to its ability to absorb water and swelling capability. Crosslinked PAM can be placed in bags made of loosely woven material, such as weed-barrier fabric, and placed into large holes and covered with soil and rocks to hold the bags in place. The PAM will hydrate and swell when it is contacted by water and will fill the hole.

III. SEDIMENT EFFECT:

Our testing indicated that sediment is necessary to effect sealing. The linear PAM will floc the sediment in the water and effect the seal. Both PAM's are also UV sensitive, and a sediment blanket covering the PAMs will protect the life of the PAMs. In sediment-laden canals this is achieved naturally. However, in clear water situations or after the initial sediment-laden flow, sediment should be dispensed into the water with the linear PAM. Testing has proven that higher quantities of sediment increase sealing rates and the addition of more sediment at later intervals will enhance sealing.

IV. POLYMER APPLICATION IN CANALS:

SOILS: The soil type of your canal or lateral will determine how much PAM and/or other material will be required to effect a seal. In these applications, the amount of PAM required is measured in pounds per canal acre. The other materials: sediment, bentonite or crosslinked PAM, are also measured per canal acre. Hundreds of pounds of these materials may be required.

First, take soil samples from known trouble spots along your canal or lateral. If your soil is a clay soil, the least amount of polymer will be required. Silty soil will require more PAM, however, if either clay or silty soil has sand present, the PAM amounts will be higher and the higher the sand content, the more PAM required to seal. In general, a range of 8 lbs. - 20 lbs. per canal acre will be used. (See chart on in back.) Some of the worst case scenarios are old stream beds that cross your canal as these usually contain pebbles and rocks which complicate sealing just as sand does. Watch out for these areas for special treatment.

EQUIPMENT TO MIX & APPLY POLYMERS PROPERLY:

It is essential that the proper equipment be used. This can be accomplished by contracting the work with an experienced contractor or by modifying or purchasing your own spray rig. Hydroseeding rigs work very well both mixing and applying the PAM. There are elements of the equipment that you select that can make a successful operation or a failure.

Pumps: There is still some debate over the preferred pump to use. A centrifugal trash pump and a gear pump have been used successfully. Positive displacement pumps, such as gear, roller, or piston pump can be used if the PAM only goes through the pump **ONCE-recirculating with a positive displacement pump will damage the PAM.** The pump capacity or volume in gallons per minute will depend on the size of your canals and the speed of travel while spraying. The pump should operate between 40 to 100 psi.

Spray Pattern: There are numerous nozzles to choose from. DO NOT use small i.d. nozzles of less than 3/32" opening and pump pressure in excess of 100 psi as these will also shear the PAM. Boomless nozzles work well and can spray the thick higher concentration mixtures very efficiently.

Mixing PAM with water: This is a very important part of the operation and must be done properly. There are two preferred methods to mix dry PAM with water for spraying applications. Hydroseeding rigs utilizes nozzles positioned inside the tank for agitation or mechanical augers. Both are very effective for proper mixing. Mixing systems using paddles are also acceptable. The dry PAM can simply be poured **SLOWLY** into either of these systems after the tank is filled with water. It is very important to pour the dry PAM at a slow consistent rate to prevent the PAM from clumping or forming gel blocks. Generally in warm weather the PAM will be thoroughly mixed with the water within 10 minutes.

In clear or semi-clear water, additional sediment is required. Using a backhoe, drop a scoop of sediment into the water and stir it with the backhoe while dry PAM is introduced 50 feet or more downstream from the backhoe. Continue this process every 200 feet through the area to be treated. In extreme cases where no sediment is available, a heavy liquid PAM mixture can be used and must be sprayed on the water surface.

V. POLYMER APPLICATIONS FOR SEALING PONDS: The same equipment used for canals can also be used for pond sealing. The basic difference is there is generally no flowing water carrying sediment across the pond surface. The pond water is not moving and as a rule 2 to 3 times the amount of PAM is needed to seal. To seal your pond properly a soil sample should be taken and tested. There are four basic methods of sealing ponds using PAM's. All are much less costly than liners.

Linear PAM & Bentonite: This is the most expensive and also most effective of the four methods. Using linear PAM with bentonite allows you to use less of the costly bentonite. The bentonite is spread in a layer on the dry surface of the pond in a pre-determined thickness and then worked into the top few inches of soil. Then that surface is sprayed with liquid linear PAM and a sediment blanket around 1/8" thick is spread on top of that. Care must be taken when filling the pond after treatment, use a long sheet of landscaping fabric or other material for the water to flow on as the pond fills.

Crosslinked & Linear PAM's: Crosslinked PAM is incorporated into the DRY pond surface, sprayed with the liquid linear PAM and then a 1/8" sediment layer is spread over the top for UV protection.

Combination of Bentonite, Crosslinked & Linear PAM's:

The bentonite and crosslinked PAM are incorporated into the soil of the DRY pond surface, sprayed with the liquid linear PAM and a 1/8" sediment layer spread on top.

Wet Pond Surface or Some Standing Water in Pond: If the pond cannot be dried out a water-borne application can be used. The wet or standing water areas can be treated with a bentonite slurry followed by liquid linear PAM sprayed over the surface. Dry areas of the pond should be treated with one of the dry surface treatments based on the soil sample test.

Leaking Pond or With Standing Water: This type of situation can be treated with a bentonite slurry followed by the liquid linear PAM sprayed on the surface, or the liquid linear PAM alone sprayed on the surface. A series of PAM spray treatments may be necessary. This treatment will slow the pond leakage and with time and additional treatments usually a satisfactory result can be achieved. This treatment is also the least expensive.

Note: If possible, in all the above treatments, a sediment blanket layer either put down dry or sprayed over the surface will protect the PAMs from eventual deterioration due to UV light. A soil sample and answering the same questions as in the canal sealing section will determine which treatment will be required to seal your pond.

Questions to ask yourself to determine appropriate method of application and application rate of PAM:

1. Is this application for a canal or a pond?
2. Will the area be treated wet or dry?
3. Does the canal carry sufficient sediment during the entire season?
4. Will there be enough sediment in the water during the initial treatment or will I need to add more sediment?
5. Are there any voids or holes that would benefit from

In cold weather, it will take longer to mix properly. Once the PAM is properly mixed with water, it stays in solution. Inductor systems can also be used if your equipment can recirculate using a centrifugal pump to the PAM can be thoroughly mixed.

Inductor picture

Hydroseeding Units: There are numerous companies that manufacture and sell these systems. Most of them can be found on the internet. There are skid, trailer or truck-mounted units. A typical system, shown below, should have a hose reel to reach difficult areas or to walk and spray and a tower gun to spray over wide areas. The tank size with pump and mixing system will depend on your requirements.

spray rig picture

Options to Consider: If at all possible, the best method is to spray the liquid PAM on a dry canal or lateral surface with a hydroseeding unit or other spray truck or apparatus. The surface should be cleared of weeds and debris. In difficult terrain with limited or no access for spray rigs, the next best option is to dispense dry PAM evenly in the dry ditch with a hand held fertilizer spreader with the amount based upon the pounds per canal acre appropriate for your soil type and ditch condition and location. This should be done no more than 4 days prior to turning water into the canal since the PAM is UV sensitive.

To calculate your canal acre: Use the chart in the back. You will need to know the length of the area to be treated and the wetted perimeter of your ditch. Or, divide your canal width into 43,560 square feet in an acre to get your canal length that measures one acre. For example, if your canal is 12 feet wide measuring from the water line on one

side down to the bottom and up the other side:

$43,560 \div 12 = 3,630$ feet of canal for one canal acre

In this case, let's assume your ditch situation indicated you were to use 12 pounds per canal acre. To dispense dry PAM divide 3630 by 900 feet and you would need 4 applications of 3 pounds each-900 feet apart. Apply the first 3 pounds about 300 feet upstream from the section you want to treat in a 20 foot swath from water line to water line, then another 3 pounds 900 feet downstream and so on. If you are treating more than one acre of ditch, continue with 12 pounds per canal acre until you are through the complete section that you want to treat. You start above the section you want to treat to allow the PAM time to floc the sediment and drop to the canal surface or the first 300 feet of your section would have no treatment. The PAM can also be applied by walking the ditch and dispensed evenly throughout the area to be treated.

Treating Running Water: If the canal system is already turned on with water flowing in the canal you must determine whether or not you have sufficient sediment, some sediment or no sediment in the water. If there is sufficient sediment in the water and the water cannot be turned off easily, you can apply PAM over the running water using a hand-held fertilizer dispenser. A mechanical dispenser placed about 300 feet above the area you want to treat to slowly dispense the PAM into the running water may also be used. A fish feeder dispenser with a windup mechanism that will dispense over a 12 to 24 hour period works well for this. PAM blocks and pellets are also available for use that would slowly dissolve in water. These are put in an onion-type sack which is placed in the canal. This process can also be used to help continue sealing during the season in problem areas that have also been treated when the canal was dry.

pretreatment with a crosslinked PAM?

Safety: Wear a dust mask, safety goggles, and plastic or leather gloves to prevent possible irritation.

This Is a Guide Only Indicating Which Soils Require Higher Linear Pam Rates (A Soil Test Should Be Run to Determine Rates)

Conglomerates Old river beds						
Coarse Sand						
Medium Coarse Sand						
High Sand %						
Medium Sand %						
Shale						
Silt						
Silty Clay Loam						
Silty Clay						
Fine Sandy Clay Loam						
Fine Sandy Clay						
Clay						
Pounds/Canal Acre	8	10	20	*30	*40	**50

*Addition of Hydrogel PAM probably required for best sealing

**Addition of Bentonite and/or Hydrogel PAM required for best sealing

CANAL ACRES

ft
 528
 1056
 1584
 2640
 3168
 3696
 4244
 4752
 5280

Length (miles)	Canal Width (wetted perimeter ft)									
	2	4	6	8	10	12	14	16	18	20
0.1	0.02	0.05	0.07	0.10	0.12	0.15	0.17	0.19	0.22	0.24
0.2	0.05	0.10	0.15	0.19	0.24	0.29	0.34	0.39	0.44	0.48
0.3	0.07	0.15	0.22	0.29	0.36	0.44	0.51	0.58	0.65	0.73
0.4	0.10	0.19	0.29	0.39	0.48	0.58	0.68	0.78	0.87	0.97
0.5	0.12	0.24	0.36	0.48	0.61	0.73	0.85	0.97	1.09	1.21
0.6	0.15	0.29	0.44	0.58	0.73	0.87	1.02	1.16	1.31	1.45
0.7	0.17	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70
0.8	0.19	0.39	0.58	0.78	0.97	1.16	1.36	1.55	1.75	1.94
0.9	0.22	0.44	0.65	0.87	1.09	1.31	1.53	1.75	1.96	2.18
1	0.24	0.48	0.73	0.97	1.21	1.45	1.70	1.94	2.18	2.42

MATERIAL SAFETY DATA SHEET

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1. IDENTIFICATION OF THE PRODUCT AND THE COMPANY

Tack Dry

Supplier :

Precision Polymer Corporation
2305 33rd Avenue
Greeley, Colorado 80634
Tel: (970) 330-3319 Fax: (970) 330-3048

2. COMPOSITION/INFORMATION ON INGREDIENTS

Identification of the preparation : Anionic water-soluble polymer

Identification of the substance :

3. HAZARDS IDENTIFICATION

Aqueous solutions or powders that become wet render surfaces extremely slippery

4. FIRST AID MEASURES

Inhalation : Move to fresh air.

Skin contact : Wash with water and soap as a precaution. In case of persistent eye irritation, consult a physician.

Eye contact : Rinse thoroughly with plenty of water, also under the eyelids. In case of persistent eye irritation, consult a physician.

Ingestion : The product is not considered toxic based on studies on laboratory animals

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media : Water, water spray, foam, carbon dioxide (CO₂), dry powder

Special fire-fighting precautions : Aqueous solutions or powders that become wet render surfaces extremely slippery

Protective equipment for firefighters : No special protective equipment required.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions : No special precautions required.

Environmental precautions : Do not contaminate water.

TACK Dry

Methods for cleaning up : Do not flush with water. Clean up promptly by sweeping or vacuum. Keep in suitable and closed containers for disposal. After cleaning, flush away traces with water.

7. HANDLING AND STORAGE

Handling : Avoid contact with skin and eyes. Avoid dust formation. Do not breathe dust. Wash hands before breaks and at the end of workday.

Storage : Keep in a dry, cool place (0-35°C).

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering controls : Use local exhaust if dusting occurs. Natural ventilation is adequate in absence of dusts

Personal protection equipment

- *Respiratory protection :* Dust safety masks are recommended where concentration of total dust is more than 10 mg/m³
- *Hand protection :* Rubber gloves.
- *Eye protection :* Safety glasses with side-shields. Do not wear contact lenses.
- *Skin protection :* Chemical resistant apron or protective suit if splashing or contact with solution is likely.

Hygiene measures : Wash hands before breaks and at the end of workday. Handle in accordance with good industrial hygiene and safety practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

<i>Form :</i>	granular solid
<i>Color :</i>	white
<i>Odor :</i>	none
<i>pH :</i>	4-9 @ 5 g/l
<i>Melting point (°C) :</i>	Not applicable
<i>Flash point (°C) :</i>	Not applicable
<i>Autoignition temperature (°C) :</i>	Not applicable
<i>Vapour pressure (mm Hg) :</i>	Not applicable
<i>Bulk density :</i>	See Technical Bulletin
<i>Water solubility :</i>	See Technical Bulletin
<i>Viscosity (mPa s) :</i>	See Technical Bulletin

10. STABILITY AND REACTIVITY

- Stability :** Product is stable. No hazardous polymerization will occur.
- Conditions to avoid :** Oxidizing agents may cause exothermic reactions
- Hazardous decomposition products :** Thermal decomposition may produce: nitrogen oxides (NO_x), carbon oxides

11. TOXICOLOGICAL INFORMATION

Acute toxicity

- **Oral :** LD50/oral/rat > 5000 mg/kg
- **Dermal :** The results of testing on rabbits showed this material to be non-toxic even at high dose levels.
- **Inhalation :** The product is not expected to be toxic by inhalation.

Irritation

- **Skin :** The results of testing on rabbits showed this material to be non-irritating to the skin.
- **Eyes :** Testing conducted according to the Draize technique showed the material produces no corneal or iridial effects and only slight transitory conjunctival effects similar to those which all granular materials have on conjunctivae.

Sensitization : The results of testing on guinea pigs showed this material to be non-sensitizing.

Chronic toxicity : A two-year feeding study on rats did not reveal adverse health effects. A two-year feeding study on dogs did not reveal adverse health effects.

12. ECOLOGICAL INFORMATION

- **Fish** LC50/Danio rerio/96 hr > 100 mg/L (OECD 203)
- **Algae :** IC50/Scenedesmus subspicatus/72hr > 100 mg/L (OECD 201)
- **Daphnia :** EC50 /Daphnia magna/48 hr > 100 mg/L (OECD 202)

Environmental fate:

Log Pow: 0

Bioaccumulation : Does not bioaccumulate.

Persistence / degradability : Not readily biodegradable.

TACK Dry

13. DISPOSAL CONSIDERATIONS

Waste from residues / unused products :

In accordance with federal, state and local regulations.

Contaminated packaging :

Rinse empty containers with water and use the rinse water to prepare the working solution. Can be landfilled or incinerated, when in compliance with local regulations.

14. TRANSPORT INFORMATION

Not regulated by DOT.

15. REGULATORY INFORMATION

All components of this product are on the TSCA and DSL Inventories

RCRA status : Not a hazardous waste.

Hazardous waste number : Not applicable

Reportable quantity (40 CFR 302) : Not applicable

Threshold planning quantity (40 CFR 355) : Not applicable

California Proposition 85 Information : The following statement is made in order to comply with the CA Safe Drinking Water and Toxic Enforcement Act of 1986: This product contains a chemical known to the State of California to cause cancer: residual acrylamide less than 0.05% (500 ppm).

HMIS & NFPA Ratings	HMIS	NFPA
Health :	1	1
Flammability :	1	1
Reactivity :	0	0

16. OTHER INFORMATION

Person to contact : Regulatory Affairs Manager