CIR671

Iron Ochre And Related Sludge Deposits In Subsurface Drain Lines[1]

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In subsurface drains, there are four known types of sludge deposits that are associated with bacterial activity. These are ochre, manganese deposits, sulfur slime, and iron sulfide. Iron deposits, collectively named ochre, are the most serious and widespread. Ochre deposits and associated slimes are usually red, yellow, or tan in color. Ochre is filamentous (from bacterial filaments), amorphous (more than 90% water), and has a high iron content (2 to 65% dry wt.). It is a sticky mass combined with an organic matrix (2 to 50% dry wt.) that can clog drain entry slots, drain envelopes, and the valleys of the corrugations between envelope and inlet slots. Elements like aluminum, magnesium, sulfur, and silicon are often present. Ochre can usually be detected at drain outlets or in manholes as a voluminous and gelatinous mass. Unfortunately, ochre may also be present in drain sublaterals, and not necessarily at the outlets. Under those conditions, it can usually be detected by excavation of poorly drained spots in a field. There are still disagreements concerning the physical, chemical, and biological factors contributing to ochre formation. For example, the gelatinous mass can trap fine soil particles so that ochre may contain more than 30 percent sand. In addition, old ochre can become crystallized and hard.

In certain areas of the western United States, manganese, when present under suitable conditions in ground water, can form a drain-clogging, bacterially enhanced gelatinous black deposit. Manganese has not been a serious problem in the eastern United States. Sulfur slime is a yellow to white stringy deposit formed by the oxidation of the hydrogen sulfide that may be present in ground water. Soluble sulfides are oxidized to elemental sulfur, predominately by the bacteria *Thiothrix niuea* and *Beggiatoa sp*., so that globules of elemental sulfur are deposited within the filaments of the, bacteria. The fluffy masses of slime are held together by intertwining of the long filaments of the bacteria. Sulfur slime has not been a serious problem in most agricultural drains. It can be found most frequently in muck soils. It may be present in sites designed for subirrigation if the well water used for irrigation contains hydrogen sulfide.

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Iron sulfide is a gelatinous black precipitate formed from the reaction between ferrous iron and hydrogen sulfide. It will usually not stick to light sandy soil particles. It becomes a clogging agent when present in amounts that can block soil pores. Iron sulfide can be found when drains are buried in mixed soil profiles, gullies, river flood plains, or when topsoil or organic debris are used to blind the drains during installation. In general, iron sulfide should not be a serious problem for most installations that do not blind the drains with topsoil or debris of organic matter.

FERROUS IRON IN GROUND WATER

Although iron is present in just about every soil type, it may not be in soluble ferrous form. Ferrous iron is a primary raw material for ochre formation, and it must be in solution in the ground water rather than just located on soil particles. Ferrous iron will be present in the ground water of flooded soils only after the soil oxygen has been depleted. When that happens, certain iron-reducing bacteria attack and reduce insoluble ferric iron associated with mineral and organic soil particles. The biological action of the bacteria is energy intensive, so that energy sources that can be utilized by bacteria must be present. There is now sufficient evidence to indicate that iron cannot be reduced in a flooded soil without the action of specific bacteria. Reducing conditions are not enough. The bacterial bodies must be present and in direct contact with iron attached to soil particles.

There is often more ferrous iron in the ground water of sandy soils and organic muck soils than in loamy and clay soils. Sandy soils usually have the most ochre problems. Flooding sandy soils excludes air rapidly and less energy is required for bacteria to reduce iron to the soluble ferrous form. Sandy soils may receive sufficient organic carbon from plant roots or organic residues. Iron is often available from within sandy clay pockets and organic pans (spodic horizons). Organic and muck soils usually have sufficient iron and readily available organic carbon. Consequently, muck soils often have severe problems from ochre clogging. Clay soils, unless mixed with organic matter, have little if any ferrous iron in the ground water, even when flooded for extended periods. There are several reasons. First, the suitable organic carbon level is often insufficient for strong iron reduction. Second, there seems to be a strong electrochemical attraction between the ferrous iron ion and the clay particle. Soil pH is also an interacting factor because the amount of ferrous iron is usually higher in the ground water at pH values below 7.0. Soluble ferrous iron flowing in ground water enters a different environment as it approaches the drain and passes through the drain envelope. If a low level of oxygen is present, certain filamentous and rod-shaped bacteria can precipitate some of the ferrous iron, forming insoluble ferric iron and incorporating it into the complex called ochre.

PERMANENT AND TEMPORARY OCHRE

Although soil pH, soil type, soil temperature, and reducing conditions influence ochre deposition, the problem must be subdivided into two main categories. One is a temporary problem called autochthone and the other a permanent clogging difficulty, technically called allochthone (meaning: of foreign origin). Temporary ochre as a clogging factor may diminish or disappear over a period of 3 to 8 years, if drains are maintained in a free-flowing condition. It usually occurs rapidly and often can be detected at drain outlets within the first few months after drain installation. If drains can be maintained in working order, ferrous iron reaching them may diminish over a period of time. Permanent ochre is the most serious problem because it continues to be a clogging agent for the life of the drainage system, regardless of treatment. Permanent ochre problems in the United States have occurred in profiles with extensive residual iron and natural energy and from soluble reduced iron flowing into a drainage site from surrounding areas. Valleys at the base of escarpments are typical of this condition. Extensive amounts of reducible clays or boglike organic materials usually underlie permanent ochre sites. There are known ochre locations where iron originated 3 to 4 miles from a drainage site. Thus, it is important to consider topographical terrain features when estimating the potential for permanent ochre formation. In general, sites considered to have permanent ochre potential should not be tile-drained without extensive modifications in design and provisions for continuous maintenance.

PROCESSES OF OCHRE DEPOSITION

Based on controlled studies, the minimum ferrous iron concentrations that can stimulate ochre formation is between 0.15 and 0.22 mg/l (parts per million). Iron-precipitating bacteria must be present for extensive clogging to occur, even when other conditions are just right for chemical precipitation of the iron. Iron alone does not have serious sticking properties. The reaction in drain tubes is a combination of bacterial precipitation and the incorporation of chemically precipitated iron into the sticky slimes of the bacterial masses involved in the ochre matrix.

There are several kinds of processes involved in ochre deposition. All of them do not occur under the same conditions. All of the reactions do require some oxygen to be present in the drain line.

- Oxidation of the iron by certain bacteria predominantly on the outside of the organisms, as shown by electron micrograph pictures.
- Auto-oxidation (chemical change) and precipitation with subsequent accumulation of the colloidal iron on the sticky surfaces of bacterial slimes.
- Bacterially precipitated iron from complexed soluble organic-iron compounds. The soluble complex before precipitation maybe either ferrous or ferric iron.

The most effective iron-precipitating bacteria in drain pipes have been groups consisting of long filaments, such as *Gallionella, Leptothris, and Sphaerotilus.* These bacteria are large enough to be seen with the low power of a regular-light microscope. They can grow quite rapidly and the intertwined masses are capable of bridging small openings. The sticking and oxidizing properties can be demonstrated by using glass slides mounted in the flowing water (H.W. Ford, 1979). The precipitated iron and bacterial layer on the glass cannot be washed off in a stream of water. The same reaction probably occurs in drain pipes.

There are certain rod bacteria, such as *Pseudomonas* and *Enterobacter,* that can precipitate iron, but the volumes of ochre produced are not as large as with the filamentous types.

It has been noted that iron can be precipitated near the bodies of bacteria when polysaccharides are present. The polysaccharides in question are complex, rather sticky carbohydrate compounds that can be formed by bacteria. It is not known with certainty if polysaccharides formed by bacteria contain iron-oxidizing enzymes or whether only previously oxidized iron may be trapped in the slime.

There is a type of ochre that forms only at low pH, when pyritic soils are drained. Pyrites are formed from iron and hydrogen sulfide over a long period of time in flooded marine deposits. When such soils are drained, the pyrites first oxidize to ferrous iron and sulfates. The sulfates change to sulfuric acid, which lowers the soil pH below 3.5. The rod-shaped bacterium *Thiobacillus ferrooxidans,* which can function only in an acid environment, then converts the soluble iron into ochre. Pyritic soils, often called acid sulfate soils, are found most frequently in coastal agricultural areas, like northwestern Europe and the Scandinavian countries. Except for reclaimed strip mines (coal contains a significant amount of pyrites), acid sulfate ochre is not considered to be widespread in the United States.

There are variations in the compositions of ochre from different areas of the world. Those with the most organic carbon content seem to have the strongest sticking properties and are the most difficult to remove from drain pipes using acid treatments or water-jet cleaning.

Some compounds stimulate the formation of ochre by enhancing growths of bacteria that are involved in iron precipitation. Low concentrations of tannic acid, hypochlorous acid (bleach), and acrolein (a toxic aldehyde compound) below biocidal strength can actually stimulate bacterial activity and subsequently increase ochre deposition.

Organo-iron complexing is a complicating factor that makes it difficult to predict rates of precipitation. Iron will complex with a large number of organic compounds, such as humic, tartaric, lactic, ascorbic, and citric acids, as well as another group called aromatic hydroxyl compounds. The complexes, which can enhance ochre deposition, are usually stable and can remain in solution even in ponds and canals. In contrast, certain of the same organs-iron complexes can inhibit ochre formation. In controlled studies, tannins inhibited bacterial activity at 10 ppm (but they stimulated ochre production at 1 ppm).

In summary, while iron flowing into drains is a necessary condition for ochre formation, it is difficult to predict with accuracy the quantity of ochre that may form. The biotic factors at any given location can only be assumed because they seem to be everywhere.

WHERE IS OCHRE DEPOSITED?

Ochre can be found in the drain filter envelope, the zone abutting the envelope, the openings (slots or holes) in the drains, and within the drain tube itself. Most clogging in 4-inch diameter corrugated polyethylene tubing can be traced to sealing of the inlet openings and accumulations within the valleys of the corrugations, particularly when synthetic drain envelopes are used. Within the tubing itself, the heaviest accumulation of ochre appears to be in the lower third of the drain length, although the lower third is usually not the region of maximum ochre formation.

SOIL CONDITIONS THAT CONTRIBURE TO OCHRE FORMATION

Extensive surveys have been conducted throughout the United States to determine if there are relationships between soil types and ochre accumulation in drains. Types of soils that appeared to show the most potential for ochre formation were fine sands and silty sands, organic soils and soils with organic pans (spodic horizons), and mineral soil profiles with mixed organic matter. Gullies, flood plains of rivers, and depressions containing organic residues frequently encounter ochre problems. Sites being utilized for sprinkling of sewage effluent and cannery plant wastes usually furnish sufficient energy for reduction reactions. Therefore, all sprinkled soil should be considered potentially serious for ochre hazard if the profiles can undergo flooding for extended periods.

The least likely candidates for ochre hazard were found to be silty clays and clay loams. When flooded, they were usually deficient in ferrous iron in the soil solution.

It is possible to survey individual soil types for ochre potential. The method involves incubation of soil samples in the laboratory (H.W. Ford, 1982). In Florida, 50 soil types were considered suitable for citrus trees after drainage. Of these, 26 were rated serious for ochre-forming potential. Six were rated serious for permanent ochre and 20 for temporary clogging.

Ochre sites are not uniformly distributed, although they have been found in most states in the United States. For drainage installations as a whole, probably less than 10% are subject to ochre hazard.

MEASURING IRON IN THE GROUND WATER

It is possible to estimate the maximum potential for ochre before installing drains, as well as to estimate whether specific soil types or profiles can be considered susceptible.

The ferrous iron content of the ground water flowing into a drain has been found to be a reliable indicator of the potential for ochre clogging. The need for an easy, reliable method has been recognized and several systems have been devised, and discarded. Analyzing the soils for total iron is of no value because the values do not indicate easily reducible soluble ferrous iron nor the complex interactions between soil pH and soil type.

The details of a reliable and rapid testing procedure (H.W. Ford, 1982) that can be used to measure the ochre clogging potential before installing drains has been developed and tested extensively in numerous locations in the United

States. Ten ml of on-site ground water can be collected in syringes and pressure filtered through 0.45 micron membranes into a sulfamic acid-phenanthrolene reagent in completely closed systems. The reagent turns red with ferrous iron. Soil samples, either air-dried or moist, will yield results similar to ground water. The soil is placed in test tubes containing water and incubated at 30 degrees C for 2 weeks. A supplemental energy source can also be added to tubes as a basis for establishing whether the soil is deficient in natural energy. After incubation, the supernatant is filtered (the same as for ground water) into sulfamic acid reagent. The ground water procedure and the soil incubation method permit such variables as pH and soil type to be ignored because the tests measure only the soluble iron in solution which would be available for ochre formation. If certain terrain features are known, the test results are helpful in estimating whether ferrous iron is flowing in from surrounding areas or escarpments and whether the potential ochre problems may be permanent or temporary. The most information can be obtained when the ground water method and soil method are used together. For example, ground water readings higher than soil incubated "water only" readings usually indicate that the ferrous iron in the profile is coming from a different depth zone or the field has been flooded for a long period.

One of the more promising possibilities for the soil incubation method may be for rating soil types that have been collected by soil survey teams. In Florida, soils stored for 3 to 5 years still contained iron reducing bacteria. The soils were suitable for estimating ochre potential for individual soil types. There are limitations to such a broad-based system, but the results could serve as an initial point of reference.

There are certain on-site observations that may give clues to potential ochre formation in advance of drainage. Surface water in canals may contain an oil-like film that is usually iron and may contain *tothrix* bacterial filaments. Gelatinous ochre may form on the ditch banks or bottoms of canals. Ochre may also form layers in the soil profile. In some locations, there may be iron concretions or so-called iron rocks. The presence of spodic horizons (organic layers) suggest ochre potential, and most organic soils, such as mucks, have some potential for ochre problems.

MEASURES TO MINIMIZE DRAIN CLOGGING

There is no known economical, long-term method for effectively controlling ochre clogging in drains having serious ochre potential. Although options are limited, the emphasis must be on "living with the problem." It is necessary to follow certain practices to minimize the potential.

Precipitating Iron in the Soil by Promoting Oxidation

All measures that minimize the development of anaerobic flooded conditions are acceptable. Closer spacings and shallower depths of drains may, for certain sites, be beneficial. The fundamental point is that iron cannot flow in the ground water until.it is reduced. Soil aeration prevents reduction. A number of methods have been tried and recommended for soil aeration, but they have limitations. If soil type and soil moisture permit, immature soils containing high levels of ferrous iron could either be predrained with mole drains or by trench drains. The method can be used only on sites that have temporary clogging hazard and clay contents of about 30%. It is quite possible that iron precipitated in the soil could, under reducing conditions, become soluble again. There are recommendations in Germany for deep ground breaking with suitable plows, use of a two-stage drain system with one drain on a different level than the first drain, and preliminary drainage with open trenches for 2 to 3 years.

Surface Liming

This has been suggested to immobilize iron. In addition to atmospheric oxygen, calcium also promotes oxidation. In theory, this method should reduce ochre by precipitating iron in the soil, but it has not worked well in practice. In one experimental site in Florida, liming served only to increase the formation of ochre by raising the drain depth soil pH from 4.2 to 6.0. The drain zone at pH 6.0 proved to be a desirable range for bacterial activity. To obtain any reasonable degree of success, the lime application must be considerably higher than for normal agricultural use. The lime must change the pH in the entire soil profile all the way down to drain depth, and liming must be undertaken as a long-term project. There are data from Germany that such high lime applications could reduce the water conductivity of the soil profile--an undesirable reaction.

Liming the Drain Trench

The purpose here is to precipitate iron and prevent ochre formation in drains. It was found to be unsatisfactory in Germany. Iron in combination with lime in the trench decreased permeability, which defeated the purpose of a permeable backfill in a drain trench.

In 1961, slag gravel from the production of elemental phosphorus was used as an envelope for drains in Florida. The system eventually failed because the slag disintegrated and formed a seal around the drain. Lime rock will do the same thing. A similar reaction occurred in Germany with the use of copper slag, but because of the bactericidal action of copper, the blockage from slag took about 8 years.

Drain Envelopes

A drain envelope or filter is necessary for sandy soils. A graded gravel envelope is best, although it can become clogged under conditions of severe ochre potential. Gravel has been used for many years, but it is no longer cost effective in some regions. Thin synthetic fabrics are now used extensively in humid areas of the United States and in locations not subject to clogging from ochre and associated slimes. The principal materials being installed at present are spun bonded nylon, spun bonded polypropylene, and a knitted sock. The materials have been evaluated for ochre clogging under laboratory conditions and the knitted polyester material showed the least clogging in all studies involving drain configurations in the bottoms of plexiglas chambers. Surveys of selected drainage sites show that ochre clogging with the synthetic materials seem to occur **first** in the slots and valleys (the space between the envelope and slots) and can be present in amounts sufficient to cause drain failure. The spun bonded fabrics also clog from ochre deposits in which the iron precipitating bacteria grow across the voids in the fabrics. The sock resisted the membrane clogging action but not the clogging of the valleys and slots. This could be a potential problem in sites rated severe for ochre.

Size of the Entry Holes in Drain Tubes

There are data from Germany to indicate that the larger the openings in the drains the longer the period before drain outflow may be severely restricted. Observations in the United States suggest ochre adheres to the frayed plastic edges abutting the water inlet slots. Cleanly cut inlet slots are essential. Small slots also limit the effectiveness of jet rinsing as a method for cleaning drains installed with synthetic envelopes. Care must be taken to insure that the size of the opening or slot is compatible with graded gravel envelopes or base soil.

Copper Placed in Filter Envelopes

This has been used with some success in Germany; the results have not been very successful in Florida. In one experiment, the copper sulfate reacted with hydrogen sulfide, forming black insoluble copper sulfide.

Copper Dumped Directly into Drains

At the upper end, this will keep the drain free of visible ochre with 3 ppm soluble copper in the line provided the pH of the water is less than 7.0. The amount and frequency of treatment may cause a pollution problem.

Self-Cleaning Grades

These have not worked well in Florida studies. Reports from other countries claim that the grade must be at least 0.5% to have any effect. The only significant effect could be washing out the growths inside the tubes.

Bactericides Incorporated into the Pipe During Manufacture

In theory, this would be an excellent method if thin coatings of ochre would not prevent release of the biocide. The method would be of benefit at sites that have temporary ochre potential, where 6 months of protection immediately after drain installation might be all that is necessary.

Submerged Outlet

This is an old recommendation that has been used with some success when the entire drain is permanently under water. There are limitations. The line must be completely under water over its entire length throughout the year. This could require that the drains be on flat grade. The depth of ground water coverage must be at least one foot, and there are unpublished.. data from California indicating coverage had to be almost 4 feet. Ochre can form if the lines should become aerated for even a short period of time.

Organic Envelope Materials

Pine and oak sawdust delayed ochre development at drain inlet openings for extended periods in Florida; however, pine sawdust eventually disintegrated at several sites subjected to alternate wetting and drying. Early studies's with cypress sawdust indicated favorable action against ochre problems, and the cypress wood did not disintegrate. Unfortunately, cypress and oak sawdust may no longer be available in quantity. The sawdust created an anaerobic environment and may have been somewhat toxic to the ochre enhancing bacteria. The sawdust also contained aromatic hydroxyl compounds that complexed iron . The use f@r envelopes of most types of peat and muck that are available in the United States should be avoided. They can increase ochre problems and enhance clogging.

Iron Complexes That Have Some Bacterial Inhibiting Activity

Tannins from Turkish oak and the Mimosa shrub will combine with iron to form ink (iron tannate), which is a black colloidal material. The inklike substance will flow from the drain as a black deposit. Iron bacteria are inhibited when concentrations of tannins are above 10 ppm. It is extremely difficult to control tannin concentrations, since the chips containing tannins are spread through the factory-wrapped straw or cocofiber filter. Tannins can affect fish populations and the black discolorations of the ditch water have caused pollution problems by exceeding the permissible limits for tannins in water. There are no sources of the factory-wrapped material in the United States. The use of a complex that has bacterial inhibition is an excellent approach, but unfortunately no other materials have been found to take the place of tannins.

Ochre Removal from Drains

The use of high and low pressure water jetting has been successful in cleaning many drains clogged with ochre. Most of the commercial cleaning has been on drains installed in gravel envelopes. Pressures as high as 1300 psi at the pump have been used. There are data from the Netherlands that the pressure at the nozzle should not exceed 400 psi in sandy soils, otherwise sand around the drains may destabilize and flow into the drain. Only limited data are available for jetting drains wrapped with synthetic envelopes and installed in sandy soils. As previously indicated, the principal problem with the synthetic envelope method is the growth of ochre in the valleys and slots of the corrugated tubing. The jetting water must pass through the slots and be deflected by the envelope in order to clean the valleys. The larger the slots or openings the better the potential for cleaning the valleys and envelope. Valleys were cleaned at 100 psi at the nozzle when the drain openings were holes rather than slots. Short, narrow slots (1/16" x 9/16") with a sock envelope restricted cleaning of the valleys at 400 psi at the nozzle. Only about 30% of the ochre was removed from the valleys of the corrugations, although the inside of the drains were cleaned. The sock was not damaged at 400 psi, and sand did not enter the drain. It was concluded that many older installations may be unsatisfactory for jet rinsing because of small slot sizes. Jetting nozzles should be designed for agricultural drains rather than municipal sewer lines.

Jet cleaning has also been unsatisfactory if delayed until the ochre has aged and become crystalline. Pressure requirements will exceed the 400 psi at the nozzle, which is suggested as the upper limit for sandy soils and synthetic envelopes until further data are available.

A second method for cleaning drains involves an acid solution to dissolve the iron. The method cannot be used with synthetic envelopes. Sulfur dioxide mixed with water forms sulfurous acid. A 2%

solution in drain lines containing less than 5% organic matter will usually remove the ochre. Up to 7% sulfur dioxide gas may be required if the organic content is high, since the acid does not remove the organic matrix easily. Sulfur dioxide is a pollutant and can kill fish unless neutralized. The acid method was used extensively in southern California but has been superseded by jet rinsing.

Hydrochloric, sulfuric, and sulfamic acids have been used, but the outflow after treatment must be neutralized to prevent pollution. None of the acids should be used on synthetic envelopes.

Installation Procedures

Installation procedures that may minimize ochre problems for shallow type drains in humid areas are listed below:

- Drains should not be installed below the water table. If possible, the soil should be dry.
- Drains should open into ditches rather than through collector systems. A small area in a field may be ochreous, so that the trouble could be confined to a single drain. Cleaning is also easier for single drains.
- Clogging in the zone abutting the envelope is more severe shortly after drain installation. The best method would be to jet the drains during the first year rather than wait until the drains are clogged. Vents at the upper ends of lines have been used as ports to pour large quantities of water into the drains for flushing action, although this method would not help clean the valleys of the corrugations.
- Shallow drains and closely spaced drains that flow infrequently are not as troublesome, even though the site may be rated serious for ochre potential.
- Drains in marl soils usually have fewer problems, unless the drains are installed deep in the soil profile.
- Avoid blinding the drain with top soil or organic materials (except sawdust). Oak and pine sawdust, either for "blinding" applications or full envelopes, may delay ochre formation in drain inlet openings for extended periods.
- Herringbone or similar drain designs should have entry ports for jet rinsing.
- Use drain tubing with the largest slots or holes allowed within the limits of national drain tubing standards. Slots or holes should be cleanly cut and without fragments of plastic on which ochre can adhere. It should be noted that both smooth bore and corrugated pipes can accumulate ochre. Published reports from Germany suggest that certain plastics may contribute to ochre formation by complexing iron on surfaces of the pipes, but no recent confirmation tests have been conducted.

REFERENCES/FURTHER READING

Ford, H. W. 1979. *The complex nature of ochre.* Kulturtechnik and Flurbereinigung 20: 226-232.

Ford, H. W. 1979. *Characteristics of slimes and ochre in drainage and irrigation systems.* TRANSACTIONS of the ASAE 22(5):1093-1096.

Ford, H. W. 1982. *Biological clogging of drain envelopes.* Proc. 2nd Int. Drainage Workshop 1: 215-220.

Ford, H. W. 1982. *Estimating the potential for ochre clogging before installing drains.* TRANSACTIONS of the ASAE 25(6):1597-1600.

Kuntze, Herbert. 1982. Iron clogging in soils and pipes--analysis and treatment. Pitman Publishing Inc., 1020 Plain Street, Marshfield, MA.