PLANT HISTORY

Moscow's first sewage treatment plant was constructed in 1918, at a cost of $62,000 and consisted of two large septic tanks with contact beds for secondary treatment. Mr. Philip Dater was the consulting engineer. City labor was used for building the plant.

In 1938 the plant was rebuilt to a mechanical, primary secondary, seperate sludge digestion with a trickling filters used for secondary treatment. Engineering was by Mr. L. R. Stockman. The Federal Government participated in one third of the cost and Federal W. P. A. labor was used for construction. The total cost was $71,000.

By 1957 this plant was too small and had to be enlarged to meet the increased sewage flow. Steven and Thompson, Portland, Oreogon, was hired to do the engineering work. Construction contract was awarded to Dunham Bros., Moscow, Idaho for a price of $195,819. The Federal Government participated in one third of total cost with the city finanacing their share of cost through bond issue.

The main elements incorporated into the new design for increased capacity consisted of larger round primary and secondary clarifiers, comminutor, additional filter distributor arms, grit removal, sludge thickner, high rate digestion, chlorination, flow meter, pumps and some building alterations. Old clarifiers was included in the design to be used as standby units. The plant designed capacity is 3.5 mgd. or 20,000 population equivelant.

Upon recommendation from the Idaho State Health Department, consulting engineers and plant superintendent, additional improvements were added to the plant in 1961. This consisted of irrigation system for lawn, prechlorination line, new digester gas control equipment, automatic chlorine feed, liquid digested sludge disposal facilities and minor renovation to some of the old equipment. A shop building and laboratory was also added. Testing equipment and chemicals was supplied for the laboratory to run all necessary tests required for quantitative and qualitative analysis for a plant of this size.

Engineering for the project was by city engineer with assistance from Steven & Thompson. The construction contract was awarded to John Thomas, general contractor, Moscow, Idaho. Total cost was $42,961 paid for with surplus imporvements funds from the city and thirty percent participation by the Federal Government.

SEWAGE TREATMENT

Domestic sewage consists of water, organic and mineral solids, dissolved organic solids and many types of bacteria some of which, if they come in contact with man, may cause disease. The organic material is continually being used as food by the bacteria which also require oxygen in direct proportion to the amount of organic material available. This they obtain from the dissolved oxygen contained in the carrier water. A body of water heavily polluted with organic material will be devoid of dissolved oxygen and will not support marine life requiring oxygen for there metabolism.

The purpose of a Sewage Treatment Plant is to remove the organic material and bacteria before being discharged into a recieving stream. The degree of treatment necessary depends on the recieving waters rate of oxygen absorbtion from the atmosphere in proportion to the amount of organic material introduced and to what further use is made of the recieving water. A given flow of sewage with a minimum of treatment, called primary treatment, might be discharged safely to a large fast flowing river while the same amount of sewage could not be safely discharged to a small slow flowing stream without further treatment, called secondary treatment. This is the case at the Moscow Sewage Treatment Plant.

Sewage recieved at the Plant, about 1.5 million gallons per day, is passed slowly through large tanks where about 50% of the organic material settles to the bottom of the tank. Floating solids are removed by skimming. These combined solids are called raw sludge and are pumped to sealed tanks called digesters. Here it is heated to 95° F., thourghly mixed with an established culture of anaerobic bacteria which bio-chemically digests it to mineral matter, gasses, water and stable organic matter. The gas produced contains a high percent methane and is utilized to heat the digester and buildings. When allowed to settle the digested sludge goes to the bottom and the water rises to the top. This water is gradually drawn off and run back through the plant for further treatment. The sludge is withdrawn, run to drying beds or hauled away for soil conditioner.

Water flowing from the primary settling tanks still contains a large amount of dissolved organic material which must be removed by secondary treatment. This is accomplished by spraying the sewage over gravel beds called trickling filters. The spraying and flow of water through the gravel exposes large areas of water surface to the atmosphere enabling it to readily absorb oxygen. Aerobic bacteria culture or film established on the gravel surface utilizes this oxygen to bio-oxidize the organic matter contained in the sewage. The resultant digested sludge is carried out with the water to a secondary settling tank where the mixture is once again allowed to settle. The sludge is removed and fed to the digesters to further stabilize or digest the sludge.

After this last stage about 96% of the original organic material contained in the sewage will have been removed. The remaining amount may be introduced into the stream where it will be diluted and will not create an appreciable oxygen demand.

A large percentage of the bacteria contained in the raw sewage has been removed with the settled organic material but there is still to many remaining in the treated sewage so that it may be safely released to the recieving stream. As the water passes from the filter beds to the final settling tank, chlorine is introduced and mixed with the flow. During the 2 hour period the sewage remains in the settling tank the chlorine disinfects or kills off most of the remaining bacteria. There will only be about 10 to 150 per 100 ml left. When these are diluted or dispersed in the recieving stream they do not create a health hazard.

The waters of the creek downstream from the plant has some use as irrigation water and at a point nine miles downstream flows through the center of the townsite of Pullman, Washington. Although not encouraged, children may inadvertantly play or wade in the creek. It is therefore necessary to see that the plant puts out as pure an effluent as possible so that it does not pollute the stream and create a health hazard to these children or other humans who may come in contact with the water.

EQUIPMENT SPECIFICATIONS

COMMINUTORS

Chicago Pump, 24", model B, Barminutor, capacity 6 mgd.
Worthington, 15", C-2, Comminutor, capacity 3 mgd.

CLARIFIERS

Dorr-Oliver, round 55' diam., capacity 165,800 gl., primary.
Dorr-Oliver Squarex, 45' square, primary standby unit.
Dorr-Oliver, round 65' diam., capacity 176,000 gl., secondary, also used as chlorine contact tank.
Dorr-Oliver, 35' Squarex, secondary standby unit.

TRICKLING FILTERS, TWO IN PARALLEL

Dorr-Oliver, 4 arm, 120' diam., distributors.
Beds are 120' diam., 7' depth, of 1" - 3" crushed basalt rock. Total hydraulic capacity, 3.5 mgd.

DIGESTERS

Dorr-Oliver, 28' diam., 22' swd., primary digester with fixed metal cover, Dorr draft tube mixer and heat exchanger.
Dorr-Oliver, 28' diam., 22' swd., secondary digester with floating cover.
Varec gas regulating equipment.
Roots-Connervile gas meter.
American Standard, gas fired, hot water boiler used for digester heating.

PUMPS
Western Machinery, 4" x 5" first stage primary sludge.
Barnes-Doroco, 10" piston pump, second stage primary sludge.
Pacific Pump, 150 gpm., secondary sludge pump.
Pacific Pump, 800 gpm., vertical mounted, filter recirculation.
Barnes-Doroco, 10" piston Pump, scum removal.

CHLORINATION
Wallace & Tiernan V notch chlorinator, series A-731, 400 lb., capacity automatically controlled by flow meter.
Chlorine supplied by 150 lb. cylinders.
Final effluent used for feed water.
Rotometer tubes and valves for post and pre-chlorination.

FLOW METER
Sparling, in-line transmitter to a recorder and totalizer.

PERSONNEL AND TRAINING

Personnel consist of two operators who are on duty from 7:00 am to 5:00 pm. Each operator works five days a week and during the other operators days off is responsible for his duties. One operator is designated supervisor, the other plant operator. The supervisor is responsible for plant administration, lab tests, records and may perform other tasks required for operation as the occasion may demand. The plant operator is generally responsible for routine plant housekeeping, building and grounds maintenance and assistance with lab tests. During an emergency such as high flows, equipment failure or power outage, one or both operators remain on duty 24 hours or untill the crisis has passed. The plant operator lives at the plant site.

During a major overhaul or repair job extra help is hired or borrowed from the street or water departments of the city.

Both operators are certified under the State of Idaho voluntary Sewage Treatment Plant Operators Certification Program. The supervisor holds a class II and the operator a class IV certificate. Most of the meetings of the Inland Empire Section of the PNPCA are attended by one or both operators during the year. The superintendent belongs to and takes an active part in the Pacific Northwest Pollution Control Association. He has served as President (1967) and this year was presented with the Operator of The Year and Hatfield Award from the Association. One or both operators attend the Sewage Operators Short Schools conducted by the Idaho State Health Department each year. Also one operator will attend the Short School to be held next year at Washington State University.

The plant was visited and tours conducted for various class groups from University and grade schools as well as Boy Scouts, Girl Scouts, 4H and Student Nurses orginizations. Also many individuals and families were shown through the plant during the year.

EQUIPMENT MAINTENANCE AND OPERATION

All equipment is inspected during daily routine plant operation, to see that it is operating properly. Lubrication is programmed according to manufactures specifications, which may vary from once daily for some equipment to twice a year for others.

While there are many minor repairs and adjustments frequently made on the equipment, the following is a listing of the major repairs that were made during the year. A card index file is maintained for equipment and repairs, parts replaced, dates, etc., for future reference.

COMMINUTORS

The Worthington comminutor worked exceptionaly well throughout the year. There were several jammings by large pieces of wood, large plastic articles and pieces of steel. These were easily removed and comminuter started again. Cutting teeth and bar were sharpened and adjusted twice during the year.

The Chicago barminutor was only used when the flow exceeded the hydraulic capacity of the Worthington. This was not over an accumulated time of about three weeks during the year. Three sets of cutter teeth rings and spacers were replaced as well as bearings and seals of cutter bar. Also cutter frame guide bar mounting broke away from the main frame, caused by a piece of 2" x 6" wood, shoving cutter away from frame during high flow. Mounting was rewelded and reinforced to frame.

PRIMARY CLARIFIERS

Clarifier wiers and skimming device is hosed and cleaned two to three times a week as required. A drive belt was replaced on clarifier no. 1. Coal tar paint applied to underwater structure last year seems to be holding up quite well after one years usage with no appreciable deterioration.

GRIT REMOVAL EQUIPMENT

The Dorr-Clone rubber apex liner and lens opening were replaced. These had buckled and worn untill they became inoperative due to abrasion of grit and softening effect of grease passing through clone. A program was started to shut down sludge pump once a day, for a brief period, to allow clone to drain down and flush out any large particles of grit or stones that do not normally come out under pressure. It is hoped this may cut down on the abrasive wear on linings.

An 8" retaining wall was installed around base of grit machine. On the floor inside the area surrounded by wall was inserted a drain. Now the grit machine may be cleaned and hosed down without the wash water spreading all over the adjoining shop floor area.

PUMPS

The filter recirculation pump motor developed a short and burned out the field windings. It was sent to an electrical shop for rewinding. This was completed in about three days. It was found that the pump packing wear sleeve was quite worn so a new one was ordered from the factory. This took about two months before the factory could fill the order. Consequently the plant operated during this time without recirculation. This caused an increase in the BOD of the final effluent, (further discussion under Plant Operation). It was decided that next time this part had to be replaced that it would be built up and turned down which would be faster and more economical than buying a new part.

Cause of the motor shorting seemed to be a failure of the winding insulation. A dead rat was found between frame and field windings which may have gnawed on the insulation untill electrocuted. Moisture entering this damaged area could have caused the final short circuiting.

A one half horsepower motor which drives the pump for seal flushing water for a larger pump developed a short and failed to operate. This motor was replaced by a new one. Cause of failure unknown.

Considerable trouble has been encountered in the past keeping the float switches adjusted for several sump pumps located in basements of plant buildings. These were replaced by switches fabricated in plant shop and consist of mercury wall light switch arranged in a manner so that they are activated by a vertical float rod. After about a years operation they seem to be working satisfactory.

FINAL CLARIFIERS

Upon draining down final clarifier no. 1, it was found that iron works underwater had become quite badly rusted do to deterioration of the coal tar type protective coating. It was therefore decided to sandblast and recoat. The old standby clarifier no. 2 was put into operation while working on the other one. Before putting the old clarifier into operation some minor repairs were made and since the protective coating on it was beginning to show signs of deterioration in places it was given a coating of cold tar paint.

Sand-blasting equipment, hoses and compressor was rented from local construction and concrete company. San-blasting sand was purchased from concrete company. Labor was furnished by two students hired and by plant operators.

Because of the good results and long life that we have had with epoxy coal tar type coating on other equipment it was decided to use this instead of the ordinary coal tar coating that had been used originally. The epoxy type is considerably more expensive but if past experience is any indication it would be more economical in the long run. Epoxy coating is a little more difficult to apply as when the catalyst is mixed into the paint it has to be applied in one hour or it will start setting in the pail and get too thick to apply. By only mixing one gallon at a time and dividing this between four painters it could be applied before setting up.

GENERAL OPERATION

Each day approxiametely three hours by one man is devoted to what we call operational chores. This consists of washing down clarifiers, sludge thickner and grit collector, the checking of motors, equipment, for proper operation and lubrication. Meters are read and recorded. The final chlorine residual is checked and recorded along with checking the chlorinator for proper operation and chlorine supply. Grit has to be removed by hauling to drying beds. The scum pit is pumped out to digesters.

Pumping scum sometimes can be quite difficult due to line stoppages and requires several backflushings before it is cleared. It's not unusual to spend two hours on this one job alone. We have tried various means to eliminate this problem but so far haven't found a satisfactory solution. All we can do is keep pumping and backflushing untill the scum is pumped out. The use of a caustic cleaning compound has helped to clear out the line but is only a temporary aid. Rodding might be a solution but believe there are two short el's in the line which would restrict the use of rodding equipment.

After chores are finished, any equipment that needs repair is fixed. The rest of the day is devoted to general plant maintenance, grounds care, sampling and laboratory work. Whenever field conditions are proper and space is available, digested sludge is hauled as required to keep digesters cleared for new production.

The following are some of the operation highlights and the month during which they occured.

February:
Lyle Brouse, plant operator, attended three day Operator Short School at Pocatello, Idaho. A wirless intercom system was purchased and units installed in laboratory, shop and operators residence.

March:
Several days were spent trimming 35 fir trees on south side of plant grounds in order to clear a secondary power line which passes through the tree tops. The limbs were rubbing insulation from wires causing shortages between limbs and wire. Trimming was done from a tall ladder set up on bed of truck and by use of limb saw fastened to a long pole. The sewage plant and City hosted the Inland Empire Section of the Pacific Northwest Pollution Control Association, for their quartely meeting. The years accumulation of grit was hauled from drying beds to University farm fields which were being plowed.

April:
Three sludge drying beds were filled with digested sludge to be dried and later hauled away by those persons requesting dried sludge for use on lawns and flower gardens.

May:
Recirculation pump motor developed a short and burned out field windings. Details of repairs under Equipment Operation.

July:
Final clarifier sandblasted and repainted, (details under Equipment Operation heading).

August:
Gas meter dismanteled, cleaned and bearings replaced.

October:
Mr. John Osborn, Federal Water Pollution Control Administration, made an evaluation survey and inspection of the plant.

Removed scum layer from secondary digester by first boiling and mixing scum layer with compressed air then pumping off by a diaghram pump to a tank truck, which was dumped on farm fields.

Water was discovered boiling from ground at east side of chlorinator house. Excavation showed the secondary sludge line had cracked completely in two, caused apparently by the pressure of settling ground above the pipe. The pipe was repaired by using 8" Dresser couplings. City Water department furnished labor and equipment to make this repair.

Orrin Crooks, plant supervisor, attended the PNPCA meeting at Penticton, B. C., Canada. He was honored at this meeting by being awarded the Idaho Operator of The Year Award during the annual banquet.

November:
The gas line from the digester to gas meter developed a constriction which would not let the gas pass freely through the pipe causing a back pressure in the digester and popping off the digester pressure relief valve. The gas collection dome cover was removed which exposed the inlet end of gas pipe to outside of digester. Connections were made at gas meter end of line so that compressed air and water could be blown through the gas line. The high velocity percolating action of water and air knocked loose and blew out accumulated rust and scale from inside pipe. As this material was blown out and settled on the digester cover the results of removal was quite evident. The cleaning process was continued for about three hours then the water was shut off and the air continued for one hour to dry out interior of pipe. The line was then put back into service with no further evidence of back pressure.

December:
During the latter part of the month, for the first time in the recorded weather history of this area, the temperature dropped to a minus 45°F, for about an eight hour period. In spite of the low temperatures no particular difficulties was encountered as far as operation was concerned. The filter beds did become somewhat covered with ice but not to the extent that the water would not pass through. One distributor stopped turning, probably due to moisture in the ball race lubricant which froze. By applying pressure to outer ends of arm and rocking back and forth we were able to get it turning again.

During the christmas holiday season, at which time the University was on vacation, the sewage flow dropped considerably. This caused a reduction in volatile solids going to the digester with a resultant loss in gas production. Since the weather remained cold,-15° to-20°F, there was difficulty in maintaining the digester heat and keeping the buildings warm. Only by keeping the buildings warm enough to prevent freezing,so as to conserve fuel, were we able to keep the digester heat within about 6°F of normal operating temperature. When school started again, it was then possible to bring the digester temperature back up to normal.

Since the middle of October, because of wet soft ground, snow cover etc., it has been immposible to haul and remove digested sludge from the plant. By utilizing the old primary clarifier as a storage tank, it is possible to thicken and hold sludge untill conditions make it possible to haul again. Whereas it is only possible to obtain sludge from the secondary digester with 3% to 4% solids, by holding sludge in old clarifier the solids settle quite readily and sludge will thicken to 8% to 9% solids. This reduces the volume by 60%. Thickned sludge is then pumped out and hauled by tank truck to the drying beds. Supernatant from clarifier overflows the weirs into the inflow line to trickling filters. This is in small increments each hour of about 125 gallons. Tests show that this has no detrimental effect on filter operation. Solids added in this manner will be further digested on filter beds and then settled out in the final clarifier to be returned to primary digester.

By utilizing this thickning process before running sludge to drying beds and using the storage capacity of the clarifier, it is possible to increase the sludge storage detention time of the plant by about six months. This allows the winter production of sludge to be held untill it can be disposed of at a more opportune time during the summer and spring months. Whenever sludge was run directly from the secondary digester to drying beds, it was difficult to to get through the winter months because of shortage of drying bed area.