Chapter 5

FIRST DECADE OF OPERATION

The history of the temporary plant in its activated sludge role is not without interest. As is noted elsewhere, sewage was turned into it on February 4, 1928. The flow, 2 mgd at that time, consisted of that from a primary plant at Compton plus what ground water leakage was entering the lines tributary to the system. No trouble was experienced getting the plant into operation on the initial flow. Everything worked well and the plant was speedily producing an effluent that rivaled well water in appearance. The contract for construction of the plant was number 104, which indicates its numerical position among the contracts already executed by the Districts, for work to be done and material and equipment to be furnished. Actually, there were forty trunk sewers completed, or under construction, at the time bids were taken for the plant. Use of the trunks, however, had to await, in most cases, construction of local sewers.

Flow of sewage into the treatment plant increased from two million gallons per day (2mgd) to about 10 mgd in two years, (1930) and then, by gradual increments, to 22 mgd by 1937.

That portion of the plant which had been built for the activated sludge process was constructed in three sections, or units, each with a designed capacity of three million gallons per day.
Under conditions imposed at Dominguez Slough, this could be readily stretched to 4½ mgd each or some 14 mgd for the entire works without undue detriment to the process. The 14 mgd flow rate was reached by 1933. From then until October, 1937, it was touch-and-go to keep out of trouble and produce an effluent that was suitable for discharge to the inner harbor at West Basin via Dominguez Slough. To be sure, more plant facilities could have been built, but this was resisted for a number of reasons. One, that the facilities already built, when converted to the process needed for discharge to the ocean at White’s Point, were adequate for many years as such; secondly, a mediocre effluent could be discharged to West Basin without undue damage or inconvenience, and thirdly, the Districts faced an action by the owners of the activated sludge process for patent infringement, based on use of the process and calculated on the design capacity of the plant.

By 1930 the flow of sewage into the plant exceeded 9 mgd and included some strong industrial wastes. About this same time, all three units of the temporary activated sludge plant were also complete, but unit 3 was being pressed into service for sludge
TEMPORARY ACTIVATED SLUDGE PLANT, 1930—By 1930, three units of the temporary activated sludge plant had been completed. Until August, 1931, Units 1 and 2 (the nearest ten long tanks and the nearest four with housing) were used in sewage treatment. The six long and two housed tanks were used for sludge digestion. Underdrained sludge beds in lower right corner.

digestion. The resultant overload on units 1 and 2 was such that it became necessary to cut down on the amount of sewage going to these units if the results in treatment were to resemble what was expected of an activated sludge process. Accordingly, the flow to each of units 1 and 2 was cut back to 3 mgd, a total of 6 mgd treated. The rest was bypassed to the effluent wet well from the pre-sedimentation tanks. The mixture was chlorinated at a rate of 50 pounds per million gallons and discharged to Dominguez Slough. The results were pretty good so long as units 1 and 2 were required to treat no more than 6 mgd total, but when this amount was increased by no more than 1 mgd, the process deteriorated rapidly.

With completion of the multi-stage digestion tanks in July, 1932, all three units were used in the activated sludge process. The plant handled 10 mgd readily and, as lines were cleaned more regularly, the treatment was extended to 12 and 14 mgd without undue trouble. All over this amount was bypassed from the pre-
FUEL OIL SKIMMING AT BIXBY — Fuel oil, released at the Columbia Steel Mills at Torrance, nearly paralyzed the Bixby plant. Weeks were required to get the plant back into fair running order.

sedimentation tanks to the effluent wet well, as previously, or bypassed directly into Dominguez Slough untreated. Industrial waste discharges were not being carefully monitored at the time and frequent upsets followed at the plant. The illicit still slops, more particularly described elsewhere in this narrative, were such as to completely upset the process for days until disconnected. A fuel oil discharge from the Columbia Steel Mills in Torrance was such as to require weeks of work to get the plant and equipment into good operating order again. Threatened with complete disconnection from all lines leading to the plant, Columbia paid the cost of the cleaning process.

The area drained by the Districts' system was the locale of many oil fields and operating wells. It was originally ruled by District officials that oil brine from the wells was not to be considered an industrial waste and hence not entitled to service in the District lines except under the terms of separate agreements to be negotiated between the District and the well, or wells, owner. Terms of such an agreement were, in brief, that the owner was to pay the District $35, plus all pumping charges incurred by the
OIL BRINE SEPARATOR AND CLARIFIER—Before discharging oil well brines into the District sewers, it was required that specifications relating to oil content, suspended solids and hydrogen sulfide be met.

District, for each million gallons of brine disposed of through the District sewers, and to prepare the waste to meet certain specified requirements before it was admitted to the sewer. Between 1927 and 1950 a great many such agreements were consummated and much of the oil brine was carried to disposal through the District system.

The obvious reason for classifying oil brine as something other than industrial waste was to control the amount of brine flow reaching the sewers as the fields aged and the ratio of brine to oil increased. It was equally obvious that the oil well owners felt that they were being unjustly treated, having to pay their proportionate ad valorem share of the cost of sewerage and then being denied the right to use the facilities without paying an additional fee. In 1950, the matter was settled to the satisfaction of all concerned by allocation to the use of those who were producing oil brines a proportion of system capacity equal to the proportion of the annual assessment paid by oil properties for all District purposes. Thus, upon complying with conditions imposed upon all industrial waste dischargers, a producing field was entitled to
service for a limited waste water disposal without further cost. Each field was considered separately and a spokesman selected by the contributors to deal with the District on a year-to-year basis. Unless otherwise requested by the owner to keep previous contracts in force, all such were abandoned and the new policy substituted.

It is undoubtedly true that exclusion of oil brines from the District sewers during the life of the activated sludge plant, except under the terms of separate limiting contracts, was helpful in plant operation. When the ocean disposal means was available in 1937, it lost most of its value and late in the 1940's, the Directors wisely rescinded the initial action while still controlling the quantity of flow.

Disposal of sewage sludge, both primary and activated, was not nearly so well understood in the era of the plant in question as later on. Two municipal activated sludge plants had been constructed in California and at both, undigested sludge was discharged to undrained drying beds or buried. The Districts’ original design followed this pattern and it was proposed that initially, crude activated and primary sludge would be drained and dried on beds without underdrains. It was almost immediately apparent that such a course of procedure was totally inadequate.

For three years after the plant was put into operation, the matter of sludge disposal was critical. By July, 1928, ten undrained sand beds had been built and were in operation. By the following December, ten additional beds were added. Until mid-1929, raw, undigested and primary and activated sludge was spread on these beds to dry. The results were moderately successful so far as drying the sludge was concerned, but the modus operandi resulted in noxious odors and the breeding of countless millions of the common house fly (musca domestica). The fly population became so great and the propagation so intense that it became necessary to destroy the larvae at the sludge surface with a portable weed burner flame.

By mid-1929, unit 3 of the plant had been constructed and from then until permanent digestion tanks were completed in July, 1931, unit 3 was used to digest sludge generated in the plant as well as to confirm data on stage digestion. Use of the tanks for
digestion was supplemented from time to time by discharging to neighboring grape, citrus and bean fields.

Obviously, sludge digestion was the essential key to open air bed drying, but as stated, digestion was not well understood at the time and the three years of trial and error, during which the underdrained beds were made to serve, the Districts developed a process of stage digestion of sewage solids which not only greatly lessened the cost of digestion, but decreased the digestion period to less than half of that in current use. The process developed by the Districts for this operation was termed "Multi-Stage Sewage Sludge Digestion" and it set the stage for improvements in this important sewerage operation that has been of great benefit to all engaged in municipal sewerage. The Districts directed additional attention to it with construction works based on the principle and placed in operation in July, 1931.

One of the reasons, if not indeed the principal one, why there had been little drying of digested activated sludge on open beds, was that it was considered impracticable to economically digest activated sludge by the processes, and with the equipment and methods employed in the digestion of primary sewage solids. While
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this seems incomprehensible now, it was current in the 1920’s and resulted in either activated sludge filtration and drying as at some eastern plants and later at Pasadena, or disposal by drying the crude product after it had been run onto drying beds as practiced at Lodi, California, and later followed for a time at the District plant. The development of the Multi-Stage Process by the Districts was accompanied by an improved heating and seeding operation that was readily adapted to activated sludge as well as to primary. The impact on sludge disposal elsewhere is evidenced by the comment and commendation of Floyd Mohlman, Chicago Sanitation District, (one of the greats in sewerage practice,) to the effect that the method was new, unique and satisfactory.

On November 19, 1928, the Districts entered into a contract with H. C. Kellogg and G. W. Preston for the sale to Kellogg and Preston of all the dried sludge to be produced at the Bixby plant during 1928, 1929, and 1930. The purchasers were to remove the dried sludge from the drying beds and were to regulate their activities so as not to hinder the District use to maximum capacity of the drying beds. The contractors were to pay the Districts $1.50 per dry ton for all sludge delivered in liquid state to them by the Districts. Two years later, Preston retired from the contracting firm, but Kellogg continued on, on a year to year basis until 1945 at which date he entered into a contract for purchase of the sludge until 1950. At this point, he again contracted for the sludge until 1955, and again until 1957. In 1958, Kellogg contracted for the purchase on Bixby sludge for a ten-year period at a purchase price per ton equal to one-seventh of his bulk sale price, f.o.b. truck at his plant in Bixby.

Since 1928, Kellogg has bought from the Districts about three quarters of a million tons of dried sludge for which he has paid the Districts in round numbers some seven hundred thousand dollars. As the output of digested sludge increased at Bixby, he bought a tract of land adjacent to the Bixby site upon which the Districts built a number of shallow lagoons for drying digested sludge. After a number of years, Kellogg agreed to transfer the land to District ownership in payment for sludge. It is recollected that Kellogg bought the land when property in the area was selling for about $1,250 per acre. The Districts paid him $1,250 per acre for it.
Today the land is worth, or rather would sell for, many times that much. To whatever Kellogg has paid the Districts in money or property, must be added the very significant savings to the Districts in not having to remove the dried sludge from the beds and transport it to suitable disposal sites, or otherwise dispose of it. Kellogg’s association with the Districts has been of significant value to both; Kellogg’s perseverance and the Districts’ confidence in him have paid off. At one time in 1955, Kellogg owed the Districts more than $130,000. In increments he paid this obligation by 1961 and currently has a well-financed fertilizer business, marketing a well-recognized product that has vastly increased public acceptance of sewage-based fertilizers.

On a number of occasions after Kellogg had established his business and was reasonably prosperous, others interested in the fertilizer business attempted to outbid him for the District sludge. Recognizing that Kellogg owned the trade names which he had made popular and had an established market for his product, the Districts were loathe to encourage any other than Kellogg to attempt processing and sale of the sludge. Based on experience with the long hard pull which had been required to establish a sewage sludge in the form of “Sludgeon,” “Nitrohumus,” “Triple Big Six” and others, which Kellogg had established and named, the District staff did not encourage a change in management of the sludge disposal sale business. Fortunately, Kellogg’s bid for the contract always appeared most satisfactory.

By January, 1931, the Districts had installed sludge digestion facilities designed following research and experiment over a two-year period. The new tanks (multi-stage) took over the process of digestion of both primary and activated sludge in such a manner as to produce a non-odorous, fast-drying product which could be processed by disposal to shallow lagoons and, thereafter, allowing the natural forces of sunlight and air movement to complete the job. The twenty underdrained beds, which had served for the undigested mass, were continued in service for a time, but soon became auxiliary to the shallow lagoons and were then abandoned. There was probably no known process of sludge digestion and drying that had not been tried, at least experimentally, at the plant during the raw sludge drying period. None seemed as adequate as
that which was finally adopted.

As noted elsewhere, effluent from the temporary plant at Bixby was pumped some 4½ miles to Dominguez Slough for disposal. Until May, 1935, power for the pump was furnished by the Southern California Edison Company. By May 1, 1935, the sludge digestion tanks were furnishing enough gas to guarantee a supply sufficient to operate an internal combustion engine to take over this job. Correspondingly, on May 1, a Clark Brothers gas engine was attached directly to the effluent pump and placed in operation using sludge gas for fuel. In June, 1938, a power unit comprising an eight-cylinder Clark Brothers gas engine hooked to a Fairbanks-Morse fifty-cycle generator was installed in a newly constructed power house: the Clark engine driving the effluent pump was moved into the power house to drive a similar generator. These two power units furnished all power and light requirements for the plant at that time. In addition to the two units noted, a standby power unit, using gasoline for fuel, was installed in the power house to provide emergency service. The latter unit had been previously installed at the Gardena Pump Plant in District 5
Earthquake (March 10, 1933) Damage, Compton — Most of the Districts' structures, being underground, suffered little damage in a quake that was intense enough to severely damage many surface structures.

at a time when the Edison circuits were not so complete. Edison Company power was used as standby for a few months in 1938 following installation of the power units and was then disconnected entirely.

On the afternoon of March 10, 1933, Los Angeles experienced a sharp earthquake. It is said to have registered 6.3 on the Richter scale. Fortunately, the quake came at such a time (about 5:00 p.m.) as to spare life and injury to many. The more important facts and statistics regarding this disturbance have been recorded elsewhere. Following are a few comments on its effect upon the Districts' sewerage system as observed and recorded.

The quake was so violent as to splash water (sewage) out of tanks at the Bixby plant. Normal freeboard is about a foot. At the effluent wet well in the plant, 2″ x 12″ planks, spanning the 6 foot wide tanks and resting in recesses in the walls, were sprung out of place and thrown from the tank as though the tank had been squeezed together at the top. Bricks in the foundation for a boiler were badly displaced. None of the equipment at any of the pumping stations below ground was disturbed.
Flow in the sewer more than doubled for a short period following the primary quake, but subsided to normal in a few days. One occurrence which could have resulted in great damage to Bixby and might have resulted in injury or death to District employees and others was escape into the sewers of so-called "casing-head" gasoline from a ruptured high pressure line. Floating through the joint outfall trunk from about North Long Beach to the plant, it created an explosive atmosphere in the line for about six miles. The condition went unnoticed until the morning following the quake. When detected, all prime movers in the plant were shut down, by-pass gates to Dominguez Slough were opened and the entire flow diverted thereto. The oil refinery, thought to be responsible, was notified of the condition and immediately dispatched Foamite trucks and tank pumper to Bixby where they took over. District employees were instructed to open each manhole between the plant and the general location of the gasoline origin and to post a guard at each until the atmosphere in the line became non-explosive. The Bixby plant resumed operation only
when all trace of the gasoline had been removed from the incoming sewage. Foamite trucks stood by for the following three or four days.

As each manhole cover was removed along the joint outfall, presence of gasoline vapor was readily apparent in the rising column of escaping air because of its "vapor wave" appearance. Fortunately, no one attempted to test its explosive characteristics except with appropriate equipment. Incidentally, a thirty-inch, reinforced concrete pressure pipe, laid without collars, and through which effluent from Bixby was pumped to Dominguez Slough, came through the quake unscathed. This would not have been considered unusual had the line been equipped with connecting collars. The line in question runs from west to east in its section of greatest hydraulic pressure. An interesting observation following the quake was that gasoline seeped rapidly through brick manhole walls. Gasoline lines nearby some of the sewers were ruptured at the time and saturated the surrounding soil. It continued to seep into the sewers for days. Later, in 1941, in digging the gasoline-saturated soil adjacent to one of the larger refineries, it became necessary to repeatedly burn the gasoline out of the soil, encountered in excavation, in order to prevent dangerous combustion from sparks made by workmen's tools. Five men were rather seriously burned during this operation.

It came as something of a shock to the plant operators that the early schedule of peak flow of sewage into the plant reversed what might ordinarily be expected in a sewer. The District trunks were all, or nearly all, pipes of large diameter, designed to take full advantage of the natural slope of the terrain they were to service. As a rule, the minimum slope of such trunks were such as to produce a velocity of not less than two feet per second when flowing at half depth, but obviously a much lower velocity when at the depth of the very early flows. The results were, to say the least, disconcerting. Length of the lines and low velocity caused the diurnal variation in flow to be at flood from about noon to midnight and at low flow from then until noon again. Unfortunately, the low flow was so low that suspended solids in the sewage dropped out and stranded in the sewers and were not moved on to the plant until the following high flow. The result was that the
high flow was not only of much greater strength per unit than the low, but was rankly septic with an immediate oxygen demand calculated to discount the beneficial effects of the activated sludge with which it was innoculated. The consequences were not so apparent, while the daily flows were not over 3 or 4 mgd per plant unit, but were very troublesome at times above that.