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DOCUMENT TO: NA DOCUMENT DATE: 1-15-58  
ORIGINATOR NAME: NA ORGANIZATION: NA  
SYMBOL: NA PAGE COUNT: 10  
SUBJECT/TITLE: TA-35, Ten Site Waste Treatment Plant

RECORD TYPE (Circle relevant type):

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ROUGH DRAFT 1/15/58

EMERGENCY

TA-35, TEN SITE WASTE TREATMENT PLANT

04-0060

Description of Plant Prior to 1957:

Ten Site is a major operating facility that has been in operation for a number of years. The radioactive wastes from this laboratory consist mainly of Ba<sup>140</sup>, La<sup>140</sup>, Sr<sup>89</sup>, Sr<sup>90</sup>, Y<sup>90</sup> and traces of Ru<sup>106</sup> and Cs<sup>137</sup>. Routine operations with Ba<sup>140</sup> and La<sup>140</sup> predicated treatment by storage alone as the method of choice with other nuclides as insignificant. Four 50,000 gallon concrete storage tanks with transfer pump and piping were provided for an estimated 6 month decay holding time. In addition the entire facility is provided with water washed air cleaning filters, which operate by tap water and/or long decayed waste from the tank farms. This feature, due to high evaporation losses in the filters, was expected to balance incoming waste volumes estimated on a 1,000 to 3,000 gal/day basis. A small neutralizing basin was later installed to protect the concrete holding tanks.

In practice, the operation of this system worked as predicted with Ba<sup>140</sup> and La<sup>140</sup> decaying out. However, due to concentration of the other nuclides it was found that primarily Sr<sup>89</sup> and Sr<sup>90</sup> became a major constituent in the longest stored wastes representing over 50% of the activity left. Build up of this nuclide in a "closed system" became a problem in the air cleaning equipment and tank overflows to the nearby canyon due to human error and greater waste volumes when "hot cell washings" were required.

Received by ER-RPF  
SEP 18 1991  
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Laboratory investigations were started to determine a supplemental treatment method to storage and evaporation as a safeguard against Sr<sup>90</sup> primarily. See Treatment of Wastes Containing Radioactive Barium, Lanthanum, Strontium and Yttrium by J. P. Hutchinson, et.al.; Sanitary Engineering Aspects of the Atomic Energy Industry; Seminar at the Taft Engineering Center, Cincinnati, Ohio, December 6 - 9, 1955. TID-7517 (Pt. 1 a) Office

of Technical Services, Dept. of Commerce, Washington 25, D. C.

From these investigations, working with a 3-6 month plant waste, the most satisfactory effluent was from a high capacity cation exchange unit in the acid cycle. A method of regeneration of the resin and treatment of this spent regenerate was found, ~~to be~~ <sup>it being</sup> necessary to justify a pilot plant scale unit.

The pilot plant was built in one corner of the air filter building consisting of a rate of flow regulator, waste from any one of the four tanks, resin column 16" diameter x 8' high with 5 cu. ft. cation exchange resin with sand and gravel support for downflow operation, solenoid valves inlet and outlet operated from level controls in the column. Normal operation rates from 2 to 3 gallons per square foot per minute. A Regeneration acid tank with air pressure controls A Spent regenerate tank with flash mixer <sup>having</sup> drains for supernatant and sludge. Sludge tanks of concrete, ~~for~~ 1,000 gallon total capacity.

The operation of this equipment was started prior to 1955 with changes made to equipment from time to time. Trouble with valves and piping necessitated replacement of the exchange column, valves, and piping with stainless steel.

Operations from one regeneration cycle to another varied considerably which was primarily due to mixing relatively fresh wastes with those held for long <sup>periods</sup>? These conditions affected the quality of effluent for total count and Sr<sup>90</sup> removed and also the gamma radiation build-up at the exchange columns and equipment. Lead brick racks were installed around the exposed side of the column and spent regenerate tank <sup>to protect the</sup> operator.

Due to overall erratic results the plant was re-designed for an additional resin column, pH controlled raw feed, and electronic controls so operation would be automatic and possible in series, parallel or either column. Lead shielding was provided for the new column. In addition a platform, heavy stirring device and crane was installed outside the filter building to mix spent regenerate sludge with cement in a 55-gallon oil drum. These drums could then be hauled directly to the hot dump. Plans were made for a sump pump in each of the four waste holding tanks with necessary piping changes.

1957 Operations:

The extensive changes planned were installed in early 1957 with exception of only one sump pump at the tank farm. This <sup>pump</sup> was placed in the tank reserved for recirculation water to the air filters (designated as T-6). An additional sump pump was ~~installed~~ installed in Tank No. 4 late in the year but due to high radiation levels at the tanks, work was suspended on completion of the installation of this pump.

<sup>with</sup>  
~~In the~~ equipment as now installed a normal series cycle is: (1) Waste from tank farm through a water meter. The rotameter was removed during the year due to continual clogging. (2) Waste mixed with <sup>14.5%</sup> acid ~~controlled~~ controlled by pH electrodes at raw waste inlet to column No. 1. The pH adjustment is controlled to maintain pH level @ 2.5 - 3.5 by a Beckman meter. Acid is fed to the raw feed by a compressed air through a solenoid valve. (3) Adjusted waste downflow through column No. 1 with inlet and outlet solenoid valves controlled through electronic panel by level probes in top of column No. 1. Discharge to a small equalizing sump to transfer pump. (4) Discharge from transfer pump to column No. 2. (5) Level probes in column No. 2 regulate

inlet and outlet flow through control panel, discharge solenoid and inlet transfer pump. (6) Waste from column can be directed to canyon or returned to the tank farm.

Parallel operation splits the raw flow to both columns and by passes the transfer pump. pH adjustment is controlled by raw flow into column No. 1 but both column inlets have the same pH adjustment. ~~PH~~ pH adjustment to the raw feed is possible on operating column No. 2 alone *by changing electrodes in Col. No 1 to influent of Col. No 2.*

One main control feature of the existing equipment as now installed is that any failure will shut the plant down and acid feed off. A cycle or run from one regeneration of the resin varies as to strength of the wastes. No hard, fast rule has been set but normally where the final effluent reaches a gross  $\beta$  of 400 c/m/ml, both columns are regenerated. Sampling is accomplished by a trip in the water meter at each 100 gallons through an electronic cycler. Quarter inch solenoid valves on raw ~~feed~~ feed, column No. 1 and column No. 2 effluent lines are actuated.

A hardness test was thought to be a fast method of determining break-through in the columns but repeated laboratory tests have failed to find a reliable correlation from this type of waste as to activity and hardness break-through. It is still necessary to continually assay samples for activity and aliquot each for total ~~maximum~~ cycle composites.

Regeneration of resin in both columns can be done separately or in series. Both methods have been used with activity removed from the resins ranging from 25 to 100% with an average of 75%.

Since this operation exposes the operator to concentrated wastes, the quickest method of two-column regeneration is employed. One hundred gallons of 30% nitric acid is filtered through both columns in series after a backwash with tap water for each. The spent acid regenerate is drained to a hopper bottomed 150-gallon spent regenerate tank with approximately 40 gallons of final rinse water over a 45 minute period. The spent regenerate is then neutralized with caustic, sodium carbonate and strontium nitrate to excess, followed by iron sulfate as a floc aid. A flash mixer is used during this process. After complete mixing the sludge is settled out, 25 to 35 gallons of the total of 140 gallons, and supernatant is drained to the tank farm. The sludge is drained to the sludge holding tanks or pumped to steel drums and mixed with cement for burial.

1957 TEN SITE OPERATION SUMMARY

1. Total gallons treated -	465,850
Gallons recirculated -	35,460
Gallons discharged -	430,390
2. Operating cycles -	16
Average volume, gallons -	29,100
Maximum volume, gallons -	61,500
Minimum volume, gallons -	7,900
3. Raw Gross Beta - Total curies	32.08
Average per cycle, c/m/ml	9,620
Maximum per cycle, c/m/ml	22,567
Minimum per cycle, c/m/ml	1,870
4. Raw Sr <sup>89</sup> + Sr <sup>90</sup> - Total curies	2.55
Average per cycle, c/m/ml	765
Maximum per cycle, c/m/ml	2,100
Minimum per cycle, c/m/ml	251
5. Final Gross Beta - Total curies	2.33
Average per cycle, c/m/ml	580
Maximum per cycle, c/m/ml	2,713
Minimum per cycle, c/m/ml	133
6. Final Sr <sup>89</sup> + Sr <sup>90</sup> - Total curies	0.24 ←
Average per cycle, c/m/ml	71
Maximum per cycle, c/m/ml	377
Minimum per cycle, c/m/ml	6
7. % Gross Beta removed -	93.1
8. % Sr <sup>89</sup> + Sr <sup>90</sup> Beta removed -	92.9
9. % Sr <sup>90</sup> of Sr <sup>89</sup> + Sr <sup>90</sup> in raw. From intermittent sampling	10 to 25
10. Sr <sup>89</sup> - M.P.C. in drinking water, c/m/ml	34.8
Sr <sup>90</sup> - " " " " " "	0.4
11. Final Sr <sup>89</sup> c/m/ml Avg. -	58.5
Ratio with M.P.C.	1.65
12. Final Sr <sup>90</sup> c/m/ml Avg. -	12.9
Ratio with M.P.C.	31.1

The above summary indicates a waste having a wide range in activity. This range is reflected in the spread of activity in the exchange columns effluent. As  $Sr^{90}$  is the most critical nuclide in this waste, it also is troublesome to remove. The maximum permissible concentration of  $Sr^{90}$  in drinking water is also low (1.8 d/m/ml). To meet these exacting standards at plant discharge, is still a goal from continued experience with pilot plant operations. Our overall <sup>1957</sup> average of  $Sr^{90}$  discharge is 31 times tolerance, which by dilution of this same amount, would meet existing requirements. Since the effluent from Ten Site pilot plant discharges to Mortandad Canyon with an intermittent stream, which in turn discharges to the Rio Grande 7 miles distant, 5 of which are in the project. Any runoff contributing to the Rio would be well in excess of the 31 to 1 dilution required.

The possibility of a contaminant leaching through the over burden to ground water is always a possibility. No test wells are located in this canyon, but wells in Los Alamos Canyon to the north and soil samples from Mortandad Canyon stream at surface, 6 inches and 2 foot depths are assayed periodically. Similar samplings are taken from the Rio Grande. All of these samples <sup>are taken</sup> in cooperation with the U.S. Geological Survey who has operated a comprehensive area testing program of the surface and ground water for the past several years. ~~have indicated the presence of  $Sr^{90}$  present,~~ <sup>To date no ground or surface water samples have indicated the presence of  $Sr^{90}$ .</sup>

This reaction by the environment has been under study here using the ~~xxx~~ local tuff in the form of cores which are subjected to leaching using many nuclides and chemical contaminants. See Tuff Core <sup>Studies</sup> Sludges in this report. ~~Our factor of safety is a natural volcanic deposit acting as a large-ion-exchange bed.~~

1957 Summary of Treatment:

In the laboratory, research with exchange resins continued for more complete removal of strontium. Late in 1956 it was found that total beta and  $Sr^{89} + Sr^{90}$  activity could be removed more efficiently ~~z~~ by adjusting the raw feed to a pH between 2.5 - 3.5. This also increased total volumes of waste for each cycle by a factor of 2. On the strength of these experiments, pH control equipment was installed as heretofore mentioned for the pilot plant. ~~Some~~ Pilot plant results <sup>have</sup> justified this addition.

Tests on improving the effluent included the use of strontium nitrate <sup>in</sup> the raw feed. This process can only be described as erratic over all ranges tried. Where substantial removals were noted, the volume of waste before resin exhaustion occurred was reduced.

~~The use of this salt~~ <sup>the addition of strontium nitrate in</sup> In spent regenerate treatment, improved this precipitation reaction 100 fold. Prior to the extensive changes to the pilot plant, work was done on <sup>fixing</sup> the sludge of the spent regenerate after neutralization and precipitation of the carbonates. <sup>by mixing with cement.</sup> Having storage space of 1,000 gallons for this concentrated waste at 20 to 30 gallons for each cycle, some permanent disposal was necessary. Various proportions of sand and cement, and cement alone, were mixed with this sludge on a laboratory scale, allowed to cure and then leached in tap water to determine how well this waste was fixed in the concrete.

Results of these tests indicated that activity, especially strontium, would leach out in water at 5 to 10% <sup>of total</sup> over extended periods of time but the factor of safety of this method in a steel oil drum deposited in our designated hot dumps over wet or vacuum dried sludge is considerable.

The concrete platform, crane and stirring device just outside the filter building was incorporated in the remodeling program and put into operation during this year.

In practice, 25 to 35 gallons of spent regenerate sludge is pumped to a steel drum where the stirring paddle is lowered into place <sup>at</sup> ~~and~~ <sup>2751</sup> a ~~1:1~~ ratio of cement mixed into the waste. Hot dump disposal is made of barrels and contents in a matter of hours as set-up time is rapid.

Emergency Measures:

Throughout the year treatment has been necessary for discharge due to space requirements in the tank farm, where a satisfactory effluent could not be maintained. Early in the year the plant was not operated when extensive changes were being made. <sup>several adjustments</sup> ~~Various breakdowns and maintenance was~~ <sup>used</sup> required on starting up the remodeled plant. Operations were necessary until July, using freshly mixed wastes at times which concentrated gamma emitters in the resin columns and subjected operating personnel to exposures in excess of 500 mr/hr. through lead shielding. At this time storage space for normal requirements were estimated at four months. This was short-lived with a general Ten Site clean-up and a breakdown of the recirculating system for the air filters, necessitating the use of tap water for the air filters which added to the waste volume.

Further difficulties caused by a partial spill of a lanthanum source with excessive washings produced excessive quantities of "hot" wastes to the tank farm. Failure of the recirculating pump was followed by breakdown of the transfer pumping system, all in a high radiation environment, <sup>making</sup> ~~so~~ repairs ~~was~~ ~~pro~~ prohibitive. Auxiliary pumps at ground level were put into operation ~~x~~ for waste transfer and a temporary connection made so the sump pump installed in T-6 could be used both for the ion columns

and the air filters. Evaporation losses in the air filters were insufficient to balance high flows so treatment of high gamma wastes was necessary.

To reduce high gamma radiation at the exchange columns and also the total nuclides to remove, a batch treatment <sup>chemical precipitation</sup> method was used in T-6 for 50,000 gallons. <sup>Consisting of caustic, iron sulfate, sodium carbonate, and calcium chloride</sup> Chemicals were mixed in 55-gallon steel drums and siphoned to the tank. Mixing in the tank was accomplished by an auxiliary pump. Surprising activity reductions were realized from <sup>100,000</sup> 6,000 to <sup>70</sup> 1,000, <sup>6000</sup> 100,000 c/a/ml beta. Sludge from this temporary precipitation process is, of course, in the tanks. An additional tank was treated in <sup>like</sup> this manner and transferred to T-6 for ion exchange treatment.

This type of treatment cannot be continued as a routine procedure due to sludge build-up in the tanks. However, it has been necessary to pre-treat 100,000 gallons in this manner during the last quarter of 1957, with every indication of <sup>a similar treatment for</sup> an additional tank in early '58. With an estimated expansion of Ten Site facilities, a continuous chemical precipitation plant followed by ion exchange columns of increased capacity seems inevitable.