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CHEMICAL EFFLUENTS TECHNOLOGY WASTE DISPOSAL INVESTIGATIONS OCTOBER, NOVEMBER, DECEMBER, 1959

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Prepared by Members of the
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Edited by: W. A. Haney

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CHEMICAL EFFLUENTS TECHNOLOGY WASTE DISPOSAL INVESTIGATIONS
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CHEMICAL EFFLUENTS TECHNOLOGY WASTE DISPOSAL INVESTIGATIONS OCTOBER, NOVEMBER, DECEMBER, 1959

Introduction

The Chemical Effluents Technology Operation performs research to investigate the chemical and physical aspects of environment contamination resulting from the disposal of plant effluents or from potential process incidents. This report is primarily concerned with plant assistance research in the field of waste disposal during the quarter October, November, December, 1959.

Ground-water monitoring data utilized in this report were obtained from samples collected routinely by the Environmental Monitoring Operation and analyzed by the Radiological Chemical Analysis Operation.

I. Interpretation of Ground-Water Monitoring Data (W.A. Haney)

Monitoring Well Sampling and Analytical Program

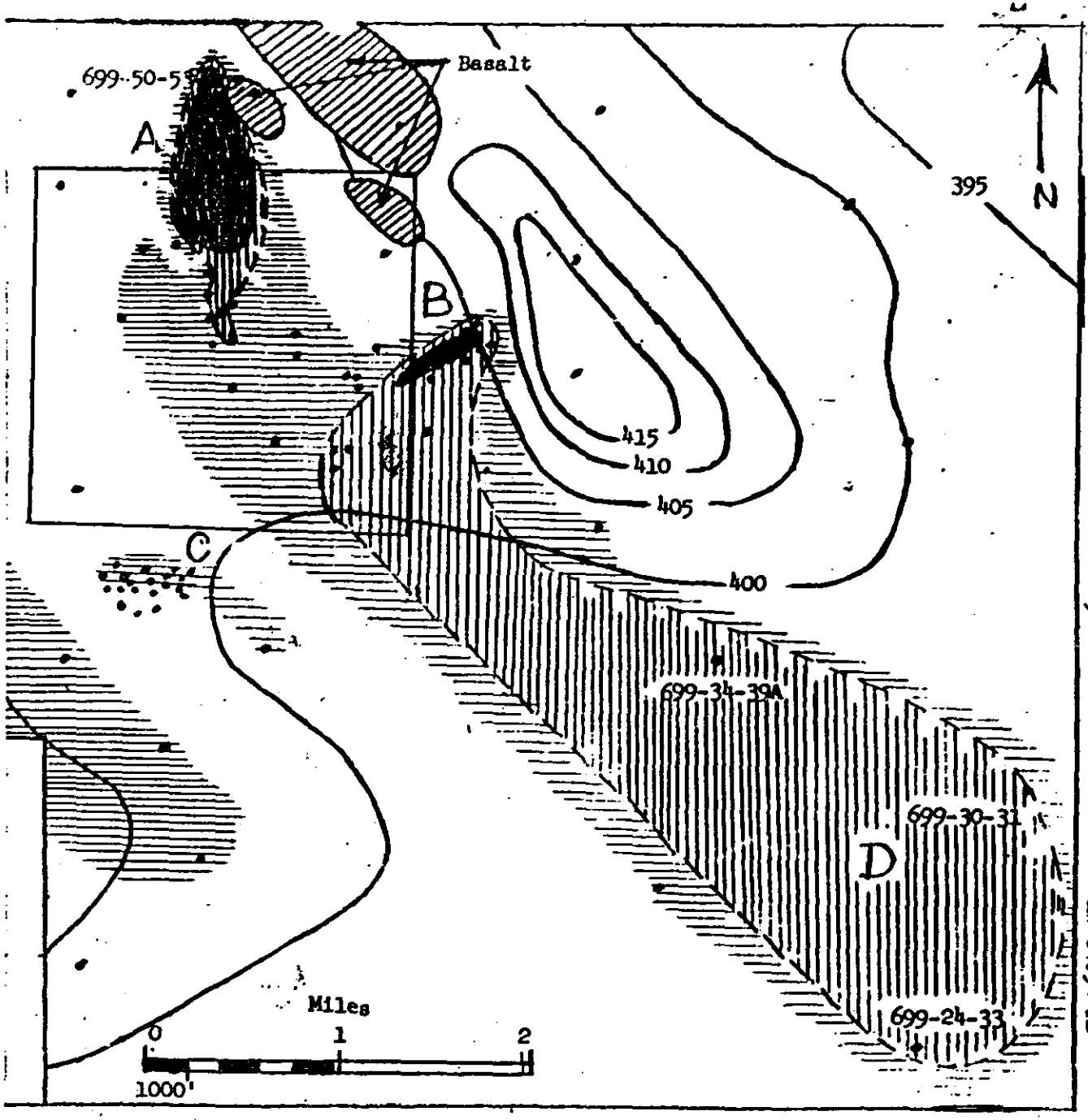
The monitoring well sampling and analytical program was revised and a new schedule placed in effect on November 23, 1959. Major revisions were less frequent sampling of wells remotely located with respect to existing contaminated ground-water zones, a reduction in the frequency but an increase in the number of wells sampled and analyzed for individual radioisotopes, and the substitution of total alpha for plutonium analysis. The revised program is expected to maintain the integrity of ground-water monitoring while at the same time affording some monetary savings.

200 East Area

Figure 1 is a map of the 200 Areas showing the extent of detectable ground-water contamination during the period October-December, 1959. Lowering of the gross beta detection limit for routine samples from 1.5×10^{-7} μc/cc to 8×10^{-8} μc/cc is reflected on the map by what appear to be appreciable increases in the areal extent of several of the lowest contamination-level zones over the past quarter. These apparent increases are due to the analytical results of samples from wells formerly regarded as "suspects" being greater than the new gross beta detection limit, rather than to a rapid movement of contaminated ground water as one might surmise at first glance.

(1) 216-BY and 241-B Cribs

Sites designated A, B, C, and D on Figure 1 are zones of ground-water contamination originating from 200 East Area waste disposal facilities. There have been only minor changes in the general size and shape of contaminated ground-water patterns at these locations, with the



rea showing probable extent of ground-water contamination
vater table, December, 1959.

exception of Site A. Well 699-50-53, located 0.6 miles north of 200 East Area, now contains radioactive contaminants from the inactive 216-BY Cribs. The presence of cobalt-60 in the well at a concentration of 1.5×10^{-5} μc/cc, about 10% of the gross beta concentration, is characteristic of scavenged waste disposed to these cribs and later entering the ground water. Other wells north of 200 East Area have shown no indication of large-scale waste migration. The presence of radioisotopes in well 699-50-53 is probably the result of local breakthrough of contaminated ground water through gaps, over or around the underground basalt ridge between the disposal site and the well.

Wells south of Site A continue to show beta-emitter concentration increases reflecting the slow southward movement of wastes from this site that was noted last quarter. No radiocesium or radiostrontium was detected in wells at Site A during this quarter; however, Co^{60} is still detectable in several wells close to the cribsite. The maximum concentration detected during this quarter was 2.1×10^{-4} μc Co^{60}/cc in well 299E-33-3.

(2) 216-A Cribs

A general decrease in the gross beta concentration levels to about one-half of last quarter's averages was noted in ten of the thirteen wells monitoring the Purex tank farm condensate cribs at Site B. The concentrations in the remaining three wells stayed quite close to the last quarter's averages. The decreasing trend is probably due to an appreciable reduction in the volume of waste discharged to the 216-A-24 crib during the past four months. The surface condensers recently installed in the 241-A tank farm condensate system have reduced the volume of waste cribbed each month to about 5% of previous monthly volumes.

Although radioisotopes of cesium and strontium have never been detected in the ground water at this site, cobalt-60 was detected in two wells this quarter at a maximum concentration of 1.0×10^{-6} μc/cc which is about the same concentration noted in several waste samples. This is another example of the relatively poor soil adsorption of Co^{60}.

(3) 216-BC Cribs and Trenches

Twenty wells monitor the ground water under the inactive 216-BC waste disposal facilities shown as Site C on Figure 1. Thirteen of the wells contained detectable concentrations of beta emitters this quarter. No definite pattern of radioactive contaminants in the ground water has been established at this disposal site, and only two of the wells have shown positive concentrations of radioisotopes continuously over the past three quarters. Although shown as a separate contaminated ground-water zone, it is not unlikely

that wastes migrating from Site A have now merged with those at Site C. No long-lived radioisotopes have ever been detected in ground-water samples from wells at this location. The highest average gross beta concentration detected this quarter was 3.4×10^{-7} μc/cc in well 299E-13-4

(4) Contaminated ground water southeast of 200 East Area

Revised ground-water contour data have assisted in establishing Purex cribs as the most likely source of the ground-water contamination shown as Site D, Figure 1. Wells 699-34-39A, 30-31, and 24-33 which contain radioactive contaminants are down the ground-water gradient from Purex cribsites. High nitrate ion concentrations (ca. 20ppm) in these wells are commensurate with high nitrate ion concentrations in Purex process condensate wastes. Wells to the east and southeast of Site D have as yet shown no evidence of waste migration, although several of the wells have consistently shown above normal nitrate-ion concentrations.

Average beta-emitter concentrations in the three wells of interest were about 30% higher than the previous quarter's results. Maximum concentrations of radioactive contaminants, averaging 9.6×10^{-6} μc β/cc, were detected in well 699-34-39A.

200 West Area

Three major areas of ground-water contamination in 200 West Area are shown on Figure I as sites E, F, and G. There have been no significant changes in the contaminated ground-water patterns other than those fringe changes resulting from the lowered gross beta detection limit.

(1) T-Plant Cribs and Trenches

Wells monitoring inactive T-Plant waste disposal sites show the presence of radioisotopes in ground water resulting from the continual drainage of several of these facilities (Site E, Figure 1). Sporadic low concentrations of radioisotopes appearing in the 299W-11 series of wells are probably a result of the movement of contaminated ground water from under disposal sites to the southwest and the continual drainage of early-day disposal sites in the immediate vicinity of the wells.

A survey of the 299W-15-1 well with the gamma scintillation well-probe was made when well-sample analytical results showed increases in beta activity which were unexplainable on the basis of existing ground-water contours. Probing revealed the presence of radioisotopes from a depth of 100 feet to ground water. The likely source of this waste is the 216-TX-5 specific retention trench located about 300 feet north of the well. A relatively impermeable, southward-dipping caliche bed at a depth of about 100 feet probably

diverted some of the waste toward the well. The trench, on the basis of laboratory tests, received about 0.3 of a soil column volume of first-cycle bottoms in 1954. This is additional evidence of the appreciable lateral movement of wastes in the vadose zone under much of 200 West Area and also indicates prolonged drainage of the waste after a facility is abandoned.

The highest average gross beta-emitter concentration reported at Site E this quarter was 2.3×10^{-5} μc/cc in well 299W-15-4. No detectable concentrations of Sr^{90} or Cs^{137} were found in the wells at this site.

(2) 216-WR Cribs

The significant change in ground-water contamination noted at the 216-WR Cribs over the past quarter was an increase in the Sr^{90} concentration in well 299W-19-2 monitoring this disposal facility (Site F, Figure 1). The increase was from a concentration of 2.2×10^{-8} μc Sr^{90}/cc in July, 1959 to a concentration of 7.9×10^{-8} μc Sr^{90}/cc in December, 1959. The contract for a replacement crib has been let, and the new facility should be available for use by about May 1, 1960. (216-U-17, in use about end of April.) W. Armstrong.

(3) Redox Cribs

No significant changes in the ground-water contamination pattern at the Redox cribs, Site G, Figure 1, have occurred over the past quarter. The probable source of radioactive material appearing sporadically in low concentrations in the 299W-23-2 and 3 wells is the 216-SX-1 tank farm condensate crib, about 1000 feet northwest of the wells. Continual drainage of the 216-S-1 and 2 process condensate cribs abandoned in early 1956 results in the presence of Sr^{90} in well 299W-22-2 monitoring the facility. This is the only well monitoring the ground water at Site G which has shown detectable concentrations of Sr^{90}. It has been consistently detected in varying concentrations in this well for almost three years. The average concentration over the past quarter was 1.2×10^{-6} μc Sr^{90}/cc which is just slightly greater than the average concentration over the previous quarter.

The maximum average gross beta-emitter concentration, 4.7×10^{-2} μc/cc, of any well on the project was noted in well 299W-22-14 monitoring the active 216-S-7 process condensate crib. The three wells at this location characteristically contain relatively high concentrations of radioisotopes; however no Sr^{90} or Cs^{137} has ever been detected in the ground water under this crib.

II. Plant Waste Disposal Practice

Chemical Processing Department (W.A. Haney)

Disposal to Ground

Data relating to concentrations of cyanide ion in ground water under scavenged waste disposal sites were communicated to Industrial Hygiene Operation for possible toxicological evaluation. Only one well, 299E-33-12, showed a free cyanide ion concentration greater than the analytical detection limit of 0.4 ppm. The CN^- concentration in this instance was 2.2 ppm. Several nearby wells contained combined cyanide, probably as the ferrocyanide ion, the maximum concentration being 6.0 ppm.

Irradiation Processing Department (W. N. Koop)

NPR Decontamination Solution Disposal

Early in October, a laboratory study was initiated to obtain information for use in investigating disposal methods for NPR decontaminating solutions. Decontamination procedures currently favored consist of either a two or three stage circulation of chemical cleaning solutions within the primary loop. Rinses will be employed between the chemical decontamination steps. The wastes generated will contain an unknown but significant concentration of potentially hazardous radionuclides. A list of twenty-five such isotopes was prepared and later reduced to fifteen for disposal study purposes.

Laboratory studies were conducted with cation exchange resins in candidate cleaning solutions, spiked with either radiocobalt or radiostrontium, to evaluate possible disposal to ground. These studies showed unfavorable ion-exchange properties, probably because the resin exchange sites were saturated by the salts in the solutions. The most significant observation was that in the case of one of these cleaners the cobalt and strontium ions were removed from solution by scavenging. One of the components of this cleaner was $KMnO_4$. It was concluded from the color change and the precipitate formed that the permanganate was reduced, and in the process radionuclides were carried from the supernatant liquid. This led to postponement of further ion exchange tests in favor of a study investigating the possibility of utilizing this reaction for the predisposal treatment of spent cleaning solutions.

Additional studies showed that effective scavenging occurs upon mixing the cleaning solutions. Concentrations of Co^{60}, Ba^{133}, and Sr^{85} were reduced to 0.1% of the initial concentrations after the mixed solution was allowed to stand for four days. Plans were made to test the scavenging effectiveness for removal of the remaining twelve radioisotopes on the disposal study list.

Fission Product Release Experiments (R. K. Hilliard, A. J. Scott)

Experiments on the release of fission products from uranium heated to high temperatures in a helium atmosphere were continued. The observed

release of all fission products -- with the exception of strontium -- was considerably less in helium than in steam or air, all other experimental conditions remaining the same. Strontium was released at about the same rate.

Table I summarizes the release of the fission products measured.

TABLE I

RELEASE OF FISSION PRODUCTS

Temperature = 1215°C Time = 24 minutes

	Percent Released From Specimen						
Atmosphere	Xe^{133}	I^{131}	Te^{132}	Sr	Cs	Ru^{103}	Ba^{140}
Helium	0.7	2.5	0.2	0.03	0.06	0.01	0.02
Steam	9	18	8	0.02	1	0.03	0.04
Air	50	65	60	0.04	1	0.7	0.1

A facility was completed in which fission product release tests on fully irradiated uranium will be performed. Preliminary work using unirradiated uranium specimens was initiated, and fission product release experiments will begin early in the next quarter.

HW-60689, "Fission Product Release from Uranium Heated in Air", and HW-61861, "A Review of Uranium Oxidation", were issued this quarter.

III. Laboratory Evaluation of Wastes (A.E. Reisenauer)

The capacity of the 216-S-7 Redox process condensate crib was evaluated by laboratory soil column techniques. Three soil column tests were performed to confirm the excellent sorption of strontium and cesium on soil that was previously observed. The 10-cm. columns were operated at a flow rate of 0.35 gal/ft^2/hr. Analysis of breakthrough curves constructed for both cesium and strontium revealed that the latter is the limiting radioisotope with breakthrough volumes of 37, 41 and 71 column volumes. The two lowest results were about one-half of the 86 column volumes capacity reported during June, 1958. Cesium-137 breakthrough values were 122 and 125 column volumes. The 216-S-7 crib has received less than 7 column volumes of waste and now averages about one column volume per year.

An informal document, HW-63121, "Laboratory Sutdies of Hanford Waste Cribs", was issued. The report presents a brief history of the development of laboratory techniques for determining crib capacity and includes

tables summarizing the present status of disposal sites of current interest. All available data to September, 1959 from which crib capacity estimations were made are included.

IV. Well Drilling Summary (D.J. Brown)

Bach Drilling Company

Completed Wells	Feet Drilled	Date Completed	Total Feet	To Water	To Basalt
699-62-43M	80	10-1-59	80	Yes	No
699-62-43N	71	10-15-59	71	Yes	No
699-48-51	167	10-22-59	167	No	Yes
699-38-65	270	12-6-59	536	Yes	Yes

Wells Under Construction

699-44-64	452
699-36-61B	295
299W-19-14	380

The Bach Drilling Company is performing services for Chemical Effluents Technology Operation as specified in Project CAH-848, contract number AT(45-1)-1467. This project calls for the construction of sixteen wells, with a total footage of 3,600 feet, and for the contractor to perform several hydrological tests in the wells.

During this quarter the Bach Drilling Company completed four of the sixteen wells and drilled a total of 1,715 feet. They also performed the hydrological tests outlined in the contract. The cumulative footage drilled is now 2,640 feet with slightly less than 1,000 feet remaining. The completion date for this project is February 27, 1960.