MASTER**ENVIRONMENTAL MONITORING SUMMARY****FOR THE****PADUCAH PLANT FOR 1970****K. A. DAVIS****UNION CARBIDE CORPORATION
NUCLEAR DIVISION
PADUCAH GASEOUS DIFFUSION PLANT**

operated for the **ATOMIC ENERGY COMMISSION** *under* **U. S. GOVERNMENT** Contract W-7405 eng 26

**UNION
CARBIDE**

PADUCAH GASEOUS DIFFUSION PLANT
P. O. Box 1410
Paducah, Kentucky 42001

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ENVIRONMENTAL MONITORING SUMMARY
FOR THE
PADUCAH PLANT FOR 1970

K. A. Davis

UNION CARBIDE CORPORATION
NUCLEAR DIVISION
Paducah Gaseous Diffusion Plant
Paducah, Kentucky

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Author: K. A. Davis

A B S T R A C T

Outdoor monitoring of air, water and vegetation in the vicinity of the Paducah Plant is summarized for the year of 1970.

Previous Reports

Environmental monitoring summaries for previous years were issued as Reports Numbered KY-624 (1969), KY-582 (1967-1968), KY-543 (1965-1966), KY-484 (1964), KY-458 (1962-1963), KY-419 (1961), KY-371 (1960), KY-332 (1959), and KY-273 (1958).

ENVIRONMENTAL MONITORING SUMMARY

FOR THE

PADUCAH PLANT FOR 1970

The Paducah Gaseous Diffusion Plant is a government-owned plant operated by Union Carbide Corporation, Nuclear Division, for the Atomic Energy Commission. In addition to the gaseous diffusion cascade, there are auxiliary units such as the uranium recovery and scrap processing units, the uranium metal foundry, and the feed plant which process large quantities of oxides and fluorides of uranium. Nitric acid is used in several processes. Significant quantities of hexavalent chromium are used each day as a corrosion inhibitor in the recirculating water of the plant cooling system; therefore, uranium fluorides, nitrates, and hexavalent chromium are of primary interest in the environmental monitoring program of the Paducah Gaseous Diffusion Plant. Other factors routinely checked are pH, alpha and beta activity, and background gamma radiation.

Air and water are sampled continuously in the vicinity of the plant; grab samples of Ohio River water are collected monthly, and vegetation samples are taken on alternate months. These samples are analyzed for the chemical which might reasonably be expected to affect the use of the air, water, or vegetation, and which may originate in effluents from the Paducah Plant. Gamma radiation readings are taken monthly at three feet above ground level at each of the nine air sampling stations.

ENVIRONMENTAL MONITORING METHODS

Air Samples: Four air sampling stations are just inside the perimeter fence, and five are approximately one mile from the plant. Air is continuously sampled at the nine locations by pumping 0.3 cubic feet per minute through a membrane filter to collect particulate matter and at the four perimeter fence locations through a weak (0.5%) sodium hydroxide solution in a conical, glass-bead-filled scrubber to collect soluble gaseous fluorides. The locations are indicated on the map (Appendix A).

The membrane filter is replaced each week and alpha and beta activity is determined by standard counting procedures. The scrubber with its solution is changed each month and the fluoride is distilled out of the bubbler and determined by back titration with thorium nitrate and sodium alizarin used as an indicator.

Vegetation Sampling: Samples consisting of about 20 grams of broad-leafed grass are collected every two months at the air sampling locations and at supplementary locations at approximately one and five miles from the perimeter fence. The vegetation samples are allowed to dry at room temperature from 15 to 20 days and are pulverized in a Wiley cutting mill prior to being analyzed for fluoride content by the Willard and Winter method.

Water Sampling: The two creeks carrying liquid effluents from the Paducah Plant are sampled continuously and the water is analyzed each week for uranium, fluorides, nitrate ion, hexavalent chromium, and pH. Alpha and beta activity is counted after evaporation. Grab samples are collected

monthly at five locations in the Ohio River, at the mouth of creek, at one upstream location in Big Bayou Creek, and from two monitoring wells.

Gamma Radiation: Gamma radiation readings are taken at approximately monthly intervals in the vicinity of the air sampling stations. The readings are taken with a NICC Model 2610A beta-gamma survey meter held at approximately three feet above ground level.

DISCUSSION OF DATA

Air Samples: The alpha activity measured on particulate samples collected at the east perimeter fence (Station PE) averaged 0.04 pCi/M^3 in 1970. The activity measured at the other stations was generally not significantly different from zero and are shown in Table I.

The average beta activity during 1970 was 0.04% of the Radioactivity Concentration Guide (RCG) for uncontrolled areas. This is a slight increase over 1969.

Gaseous fluoride concentrations (calculated as HF) averaged 0.45 ppb during 1970 at the perimeter fence, 42% less than that measured in 1969.

Grass Sampling: The concentration of fluoride-in-grass was generally above 25 micrograms of fluoride per gram of dry grass (25 ppm) at stations on government property, but at those sampling points off site, the concentrations were below 25 ppm. The sampling points are shown on the map, Appendix A, and the data are presented on Table 2. The 25 ppm level is considered a safe concentration for grazing animals.

Water Samples: Drainage from the Paducah Plant traverses the four to five miles to the Ohio River by way of two creeks, the Big Bayou on the west and the Little Bayou on the east. Liquid effluents carrying significant quantities of recirculated cooling water or chemicals from operational areas are diverted to the Little Bayou, which is entirely on government-owned land and which also mixes with the alkaline wastes from the ash disposal area of the Shawnee Steam Plant. These alkaline wastes completely neutralize all the acidity in the Little Bayou. Efforts to reduce the total amount of hexavalent chromium discharged to Little Bayou are continuing.

The Big Bayou leaves government-owned land about one-half mile downstream from the western ends of the plant storm sewers and traverses private land until it enters TVA property near the Ohio River. The water of the creek has no known use, but it is accessible to cattle. The average concentration of fluorides in Big Bayou was 0.71 ppm in 1970; the chromate concentration decreased from an average of 0.4 ppm for 1969, to 0.14 ppm for 1970. The radioactivity concentration guides used for uranium and for beta activity are those recommended by the National Committee on Radiation Protection and Measurement and published in NBS Handbook 69. The average analyses shown on Table 3 for the Big Bayou are well within these guides. The concentrations of chemicals in the grab samples taken near the Ohio River below the confluence of the two creeks indicates the neutralizing and diluting effects of the ash pond overflow.

There was no significant difference in the concentration of fluorides, chromates, uranium, pH, or radioactivity in the Ohio River below the mouth

of the drainage creeks and that in the river upstream from the Paducah Plant. The average values at the individual sampling points and the guides to which they are compared are shown on Table 3.

Ground water is also sampled to determine that uranium and fluoride wastes buried on site are not contaminating sub-surface water. Samples from two wells, one 60 feet deep drilled about 600 feet north of the principal burial area and one 80 feet deep approximately one mile north of the plantsite, have had no contamination; results are summarized on Table 3.

Gamma Padiation: Gamma radiation levels were 0.02 ± 0.01 mR/hour at all stations except one which averaged 0.04 ± 0.01 mR/hour. This station is near a storage area for UF_6 cylinders.

CONCLUSIONS

Effluents from the Paducah Gaseous Diffusion Plant operations were channeled and controlled as necessary for the environmental concentrations of chemicals and radioactivity in air, water, and vegetation to be at acceptably low levels during 1970. While the federal (FWQA) and state (Kentucky) water pollution control agencies found the chemical concentrations in the creeks acceptable in 1970, new regional (ORSANCO) standards may require additional controls on chromate in effluents.

TABLE I
OUTDOOR AIR SAMPLING RESULTS FOR 1970

Sampling Point Location	Fluorides (ppb as HF)		Uranium as Alpha Activity (pCi/M ³)		Beta Activity (pCi/M ³)	
	Range	Mean	Range	Mean	Range	Mean
PN	0.21-2.9	0.96	0-0.08	0.02	0-7.2	0.64
PE	0.15-0.60	0.40	0-0.41	0.04	0-1.5	0.38
PS	0.07-0.43	0.18	0-0.10	< 0.02	0-0.63	0.18
PW	0.10-0.94	0.29	0-0.17	0.02	0-0.86	0.29
Sub-Group	0.07-2.9	0.45	0-0.41	0.02	0-7.2	0.37
			(1% of RCG)		(0.04% of RCG)	
IN			0-0.08	< 0.02	0.02-1.2	0.23
IE			0-0.10	< 0.02	0-0.72	0.45
ISE			0-0.09	< 0.02	0-0.77	0.20
IS			0-0.06	< 0.02	0-0.63	0.20
IW			0-0.07	< 0.02	0-0.72	0.21
Sub-Group I			0-0.10	< 0.02	0-1.2	0.37
			(1% of RCG)		(0.04% of RCG)	

The zero levels indicated above are less than the 0.02 pCi/M³ Alpha and 0.1 pCi/M³ beta, lower detectable limits.

TABLE 2
FLUORIDE-IN-GRASS DETERMINATIONS

Location	1970			Average
	u g F per Gram of Dry Grass			
	Range			
PN	28	-	196	99
PE	50	-	372	211
PS	4	-	38	18
PW	13	-	46	26
IN	6	-	20	12
INE	4	-	14	7
IE	6	-	392*	76
IESE	2	-	41	16
ISE	1	-	30	11
IS	2	-	22	9
IW	3	-	58	18
INW	4	-	14	9
5NE	2	-	22	11
5SE	5	-	18	11
5SW	2	-	17	9
5NW	2	-	17	7

*The average for the year, excluding this sample result, was 13 ppb. Other sample data indicate this high level was not plant effluents. The sample location is adjacent to farm crops of tomatoes and beans and the high concentration found may be due to a pesticide containing fluorides.

TABLE 3
EFFLUENT WATER ANALYSES FOR 1970

Sample* Point	No. of Samples	Fluorides (mg F/liter)	pH Range	Chromate (mg Cr/liter)	Nitrate (mg NO ₃ /liter)	Uranium (µg U/liter)	Beta Activity (pCi/milliliter)
OHIO RIVER							
9	9	0.51	7.8 - 8.0	< 0.02		1.6	0.06
50	9		7.5 - 8.1	< 0.02			
51	9		7.7 - 8.3	< 0.02			
52	9	0.38	7.8 - 8.2	< 0.02		1.9	0.08
53	9		7.7 - 8.0	< 0.02			
Guide Concentrations		1.2	6.3 - 9.0	0.05		60,000	20
BIG BAYOU							
1	10	0.50	6.0 - 7.7	< 0.02		1	0.02
3	52	0.71	6.6 - 8.4	0.14	5	18	0.06
Guide Concentrations		5.0	-	2.0	45	60,000	20
LITTLE BAYOU							
17	52	6.2	5.4 - 8.2	1.2	45	149	0.86
MOUTH OF CREEK							
21	9	1.3	7.0 - 11.5	0.17	5	5	0.10
GROUND WATER							
11	10	0.25	6.7 - 7.5			1.5	0.01
12	10	0.38	7.0 - 9.5			1.7	0.01

* See Map, Appendix A, for locations

□ - Air and Grass ○ - Grass only ● - Water

Sampling Points — Paducah Plant Environmental Monitoring Program