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Title: TRANSITE PIPE TEST LINE - "F" and "G" Series

SUMMARY

The "F" and "G" series of experiments in the program to evaluate the rate of removal of chrysotile asbestos fiber from the inner walls of TRANSITE pipe, have been concluded. These latest series represent a continuation of the program, data from which have already been reported through the "E" series.

Average values for water pH and hardness were: "F", pH 6.0, hardness 25.6; and "G", pH 4.9, hardness 12.3. These represent an increase in acidity and a decrease in hardness when compared with the water used for the "E" series. Fiber concentrations ranged from: "F", 0.1×10^{-5} to 4.8×10^{-5} $\mu g/gal$: "G", 0.1×10^{-5} to 30.2×10^{-5} $\mu g/gal$.

A computer analysis has been made from these latest test runs together with data from earlier runs which used water of greater hardness and higher pH. This analysis shows that in all cases the rate of removal of fiber decreases with time. Comparison of data from one test run to another revealed no apparent relationship between the rate of removal and changes in the pH/hardness combination.

Contents: Introduction, Experimental, Results and Discussion, Appendix (Tables 1 - 3) (Figures 1 through 3)

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INTRODUCTION

This report is comprised of data obtained from the latest series in a program intended to determine the rate of removal of chrysotile fiber from TRANSITE pipe walls by potable water under varying controlled conditions of pH and hardness.

Data reported here cover the "F" and "G" series of test runs which used water with averages of pH 6.0, hardness 25.6 and pH 4.9, hardness 12.3 respectively. The duration of the "F" series was from November 16, 1970 to March 19, 1971; the "G" series from March 29, 1971 to June 4, 1971.

Data from earlier series run with higher pH and hardness values have been reported in Reports No. 404-56, 404-63, and 404-75.

This report includes discussion of the earlier results in comparison with the latest reported data.

EXPERIMENTAL

The analysis and sampling procedures were the same as those used in the "E" series except for relocation of the water softener to the inlet water line before commencement of the "G" sampling series. This was done on the recommendation of the water softener manufacturer and is related to minimum pH requirements for the Zeolite bed. (See Report No. 425-Int-1363, S. M. Quint, June 7, 1971)

Filters removed from the pipe loop were ashed, radioactively tagged and rubbed out. Electron microscopy was employed to produce micrographs representative of the material present in the ashed residue. The electron micrographs were then scanned visually and fiber counts performed. These were then extrapolated to calculate fiber per unit volume of water.

RESULTS AND DISCUSSION

Table 1 of the Appendix lists the average values for pH and hardness of the water used in the test series "C" through "G".

The fiber analysis results obtained for the "F" and "G" series are tabulated in Tables 2 and 3 and expressed graphically in Figures 1 and 2.

Fiber concentration reported for the "F" series ranged from 0.1×10^{-5} to 4.8×10^{-5} μg/gal; for the "G" series from 0.1×10^{-5} to 30.2×10^{-5} μg/gal. These values are of the same order of magnitude as those reported for the preceding test series.

Because of the apparent closeness of the fiber concentration values among the various test series it was decided to perform an Analysis of Variance by computer.

This analysis, performed by S. E. Lawrence of the Basic Physics Section shows that at a significance level of 95 per cent, the rate of removal of fiber from the walls of a TRANSITE pipe, under the test conditions, does not vary with changes in pH and hardness. Linear regression analysis does, however, indicate that in all cares the rate of erosion does decrease with time. This decrease in erosion rate with time is greatest for test runs "E" and "D" and least for test series "F". Run "C" and "G" fall between these, but are closer to "F".

The results of the linear regression analysis are depicted in Figure 3. In this graph the position of each curve peak on the "x" axis represents the mean slope of the straight line generated for a particular test series by the regression analysis. The area under each curve being unity the "y" coordinate is simply related to the spread of the data points. The area under a curve which lies to the left of the origin is an indication of the probability that the slope of that particular straight line is negative.

To summarize the results obtained to date in the TRANSITE Pipe Test Line experiments, we can say that for a given pH/hardness combination the rate of removal of chrysotile fiber from the pipe wall decreases with time. However, statistical analysis of the data reveals no relationship between this rate and the various pH/hardness changes.

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APPENDIX

Table 1

Average pH and Hardness - Series "C" through "G", TPTL

Series	C	D	E	F	G
pH	7.2	7.3	7.3	6.0	4.9
Hardness	105	51	24	25.6	12.3

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APPENDIX

Table 2

Ash Content and Fiber Concentration - "F" Series

Run No.	Water Sampled (gal)	Ashed Solids (mg)	Fiber in Ashed Solids (per cent)	Fiber in Water (μg/gal)
1	133,920	42.2	0.0061	0.1×10^{-5}
2	85,900	37.0	0.011	4.8×10^{-5}
3	87,100	33.6	0.0095	3.6×10^{-5}
4	87,050	28.7	0.0017	0.5×10^{-5}
5	87,100	28.7	0.0017	0.5×10^{-5}
6	85,700	35.4	0.0004	0.1×10^{-5}
7	82,000	32.8	none detected	none detected
8	80,300	36.9	0.0062	2.8×10^{-5}
9	92,160	32.1	0.0005	0.1×10^{-5}
10	91,500	35.2	0.0040	1.5×10^{-5}

Average fiber in water = 1.4×10^{-5} μg/gal

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APPENDIX

Table 3

Ash Content and Fiber Concentration - "G" Series

Run No.	Water Sampled (gal)	Ashed Solids (mg)	Fiber in Ashed Solids (per cent)	Fiber in Water (µg/gal)
1	88,900	40.3	0.020	9.0×10^{-5}
2	65,160	35.6	0.0025	1.3×10^{-5}
3	83,900	46.5	0.054	30.2×10^{-5}
4	71,700	40.3	0.0021	1.1×10^{-5}
5	88,600	67.3	0.018	14.0×10^{-5}
6	83,200	39.0	0.0004	0.1×10^{-5}
7	78,100	33.4	0.043	18.4×10^{-5}
8	67,300	34.1	0.015	7.6×10^{-5}
9	85,300	43.3	0.012	6.2×10^{-5}
10	58,300	59.4	0.0010	1.0×10^{-5}

Average fiber in water = 8.89 µg/gal

Figure 1
"F" Series TPTL

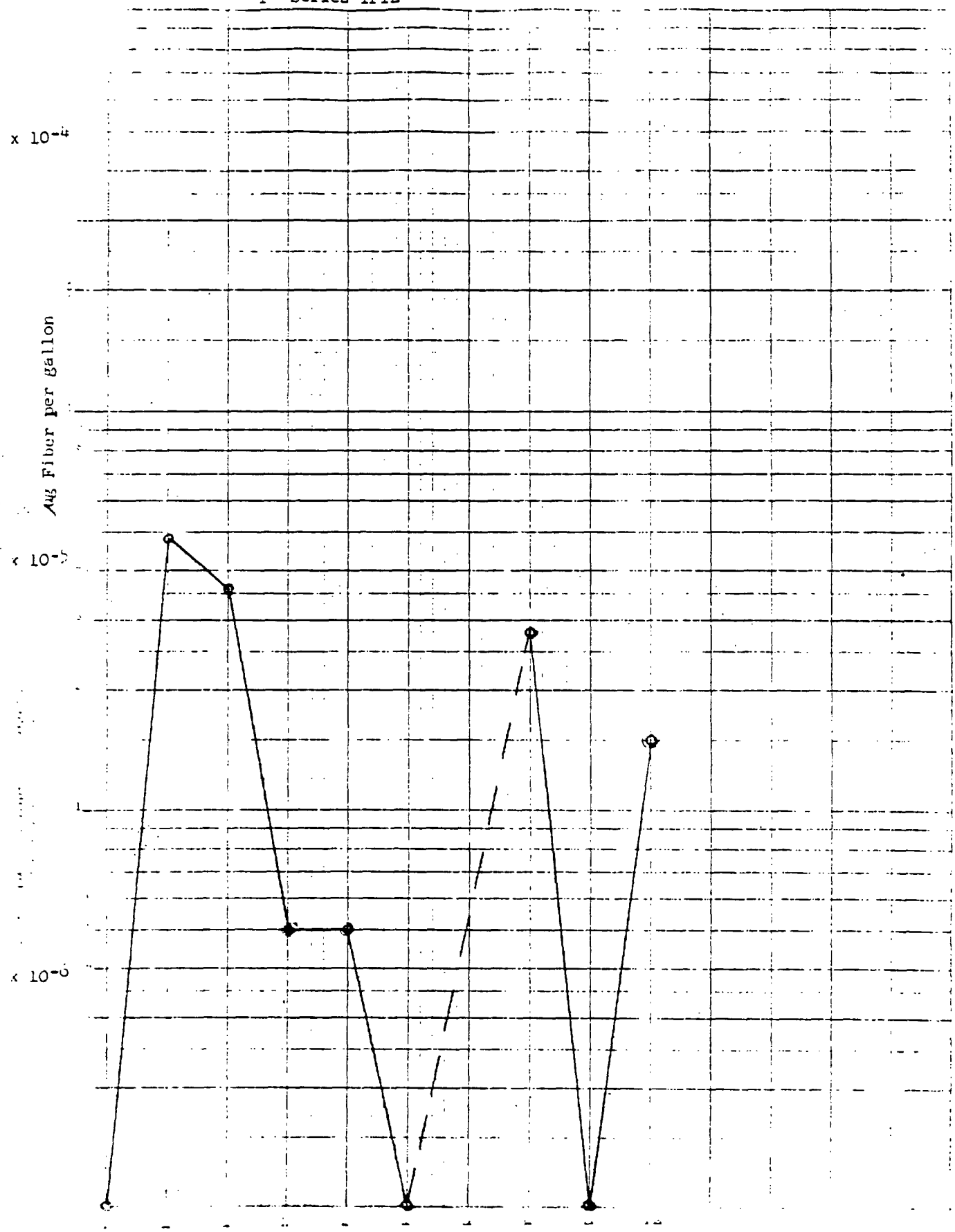


Figure 2
"G" Series TPTL

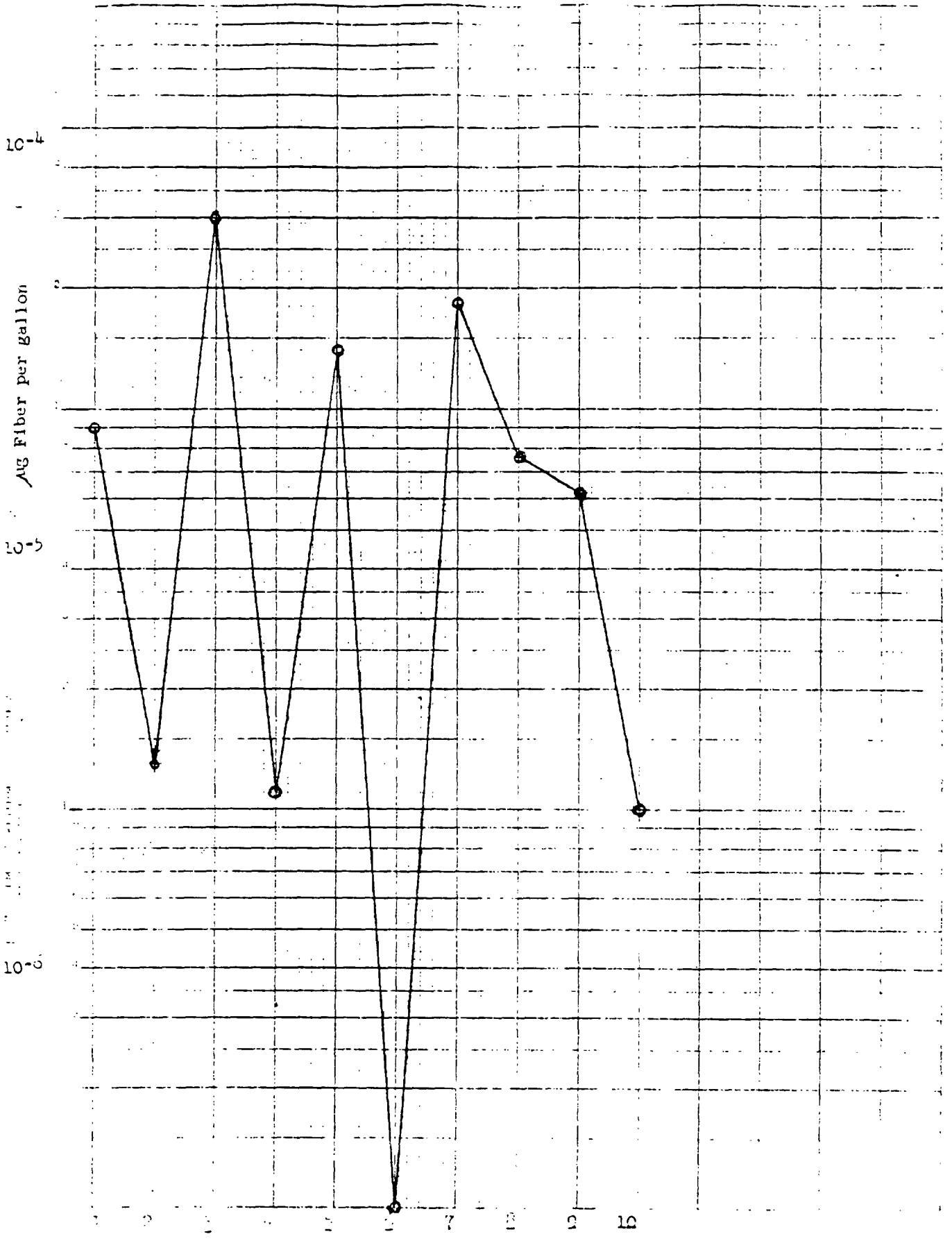
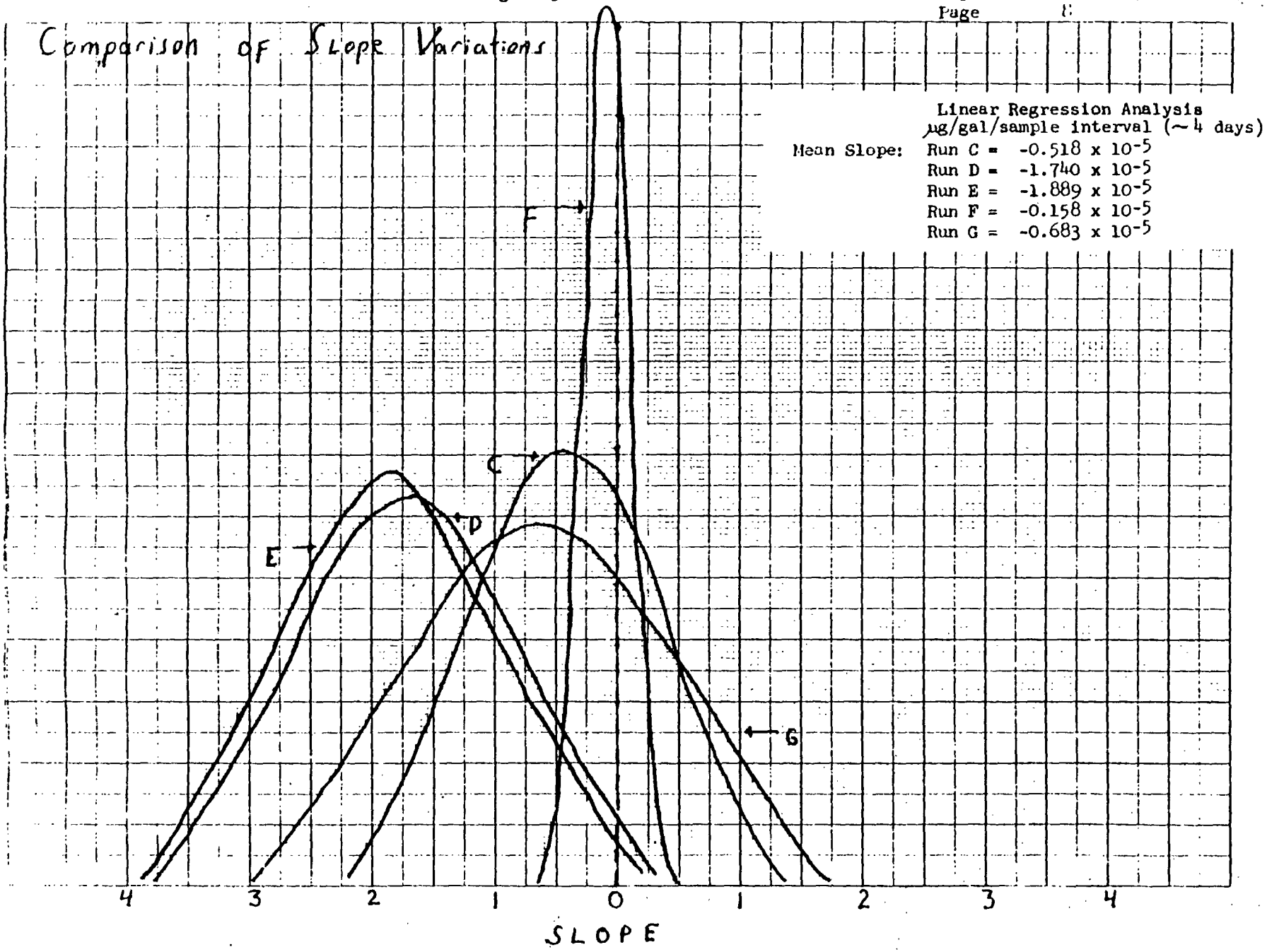


Figure 3


Comparison of Slope Variations
Linear Regression Analysis
µg/gal/sample interval (~4 days)
Mean Slope:
Run C = -0.518 x 10-5
Run D = -1.740 x 10-5
Run E = -1.889 x 10-5
Run F = -0.158 x 10-5
Run G = -0.683 x 10-5
F
C
D
E
G
4
3
2
1
0
1
2
3
4
SLOPE