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IN SITU DETERMINATION OF BUTYLTIN RELEASE RATES FROM ANTIFOULING COATINGS ON NAVY TEST SHIPS

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AN ACTIVITY OF THE NAVAL MATERIAL COMMAND

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This report presents the results of a series of in situ leach rate measurements on the hulls of three Navy test ships coated with antifouling paints containing tributyltin oxide. The flux of tributyltin from six different organotin coatings was determined under actual environmental conditions using the in situ leach rate measurement system developed at the Naval Ocean Systems Center. Values ranged from 0.18 to 3.2 $\mu g/cm^2/day$.

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EXECUTIVE SUMMARY

OBJECTIVE

Determine in situ leach rates of tributyltin on the hulls of three Navy test ships coated with different formulations of antifouling paints containing tributyltin oxide.

RESULTS

Measured leach rates ranged from a high of 3.2 μg TBT/cm^2/day. The SPC-254 coating on the USS CORAL SEA showed the lowest leach rate with a mean value of 0.24 $\pm$ 0.05 μg TBT/cm^2/day. The OMP M5211S coating on the USS MEYERKORD showed the highest value (3.2 μg TBT/cm^2/day).

CONTENTS

INTRODUCTION

The Navy is considering fleet implementation of organotin antifouling (AF) coatings. Realistic estimates of organotin flux from the fleet, preferably under actual environmental conditions, are required to assess the potential environmental impact of these coatings. This report presents the results of a series of in situ measurements made on the hulls of three Navy test ships coated with AF paints containing tributyltin oxide. Measurements were made using the in situ leach rate measurement system (ISLRMS), which was developed at the Naval Ocean Systems Center (NOSC) under the sponsorship of the Energy Office of the David Taylor Naval Ship Research and Development Center (NAVMAT 08E). The ISLRMS was originally designed for measuring the biocide flux from copper AF coatings (NOSC Patent No. 4,375,451) and, subsequently, was modified for measuring organotin release rates. Leach rate values are reported for the commercial ablative AF paint systems, ABC-2, SPC-254, and SPC-4 and also the Navy-formulated organometallic polymer (OMP) AF paints: OMP M5211F, OMP M5211S, and OMP 58S. For comparison, the organotin emission rate from two panels coated with ABC-2 was also determined using an independent laboratory procedure.

METHODS

IN SITU LEACH RATE MEASUREMENTS

The apparatus used for measurement of in situ organotin release rates is shown schematically in Figure 1. The system consists of a 12-inch diameter polycarbonate dome connected by two 50-foot lengths of 1/4-inch (inside diameter) Teflon (FEP) tubing to a peristaltic pump operated from the diving platform. Additional lengths of tubing can be added if required. An in-line vacuum gauge is used to monitor the pressure within the system, and a three-way valve is used in conjunction with the pump to collect water samples from the system.

Materials used to fabricate the system were selected based on their low adsorptivity towards tributyltin (Homer and Seligman, 1984). The dome was formed from a 1/4-inch-thick sheet of polycarbonate, and the manifolds were machined from polycarbonate stock. Viton tubing was used in the pump head and for all manifold-dome connections.

The dome (shown in Figure 2) is fitted with a double-edged gasket used to form a seal against the ship's hull. Details of the manifold system and the inlet and outlet ports are shown in Figures 3 and 4, which show top and bottom views of the dome respectively. The peristaltic pump is used to draw water from the manifold connected to six outlet ports distributed around the perimeter of the dome. The return flow enters the dome through a manifold connected to four inlet ports equipped with directional nozzles. Dye studies conducted using a prototype of the same configuration showed this arrangement produced uniform gentle mixing of the volume of seawater within the dome.

The procedure for determining in situ leach rates is as follows: the domes and attached tubing are placed in the water at the test site, and water is circulated through the system for approximately 10 minutes. This removes any water left in the system from previous measurements and equilibrates the system with the ambient water. Divers then position the dome's double-edged

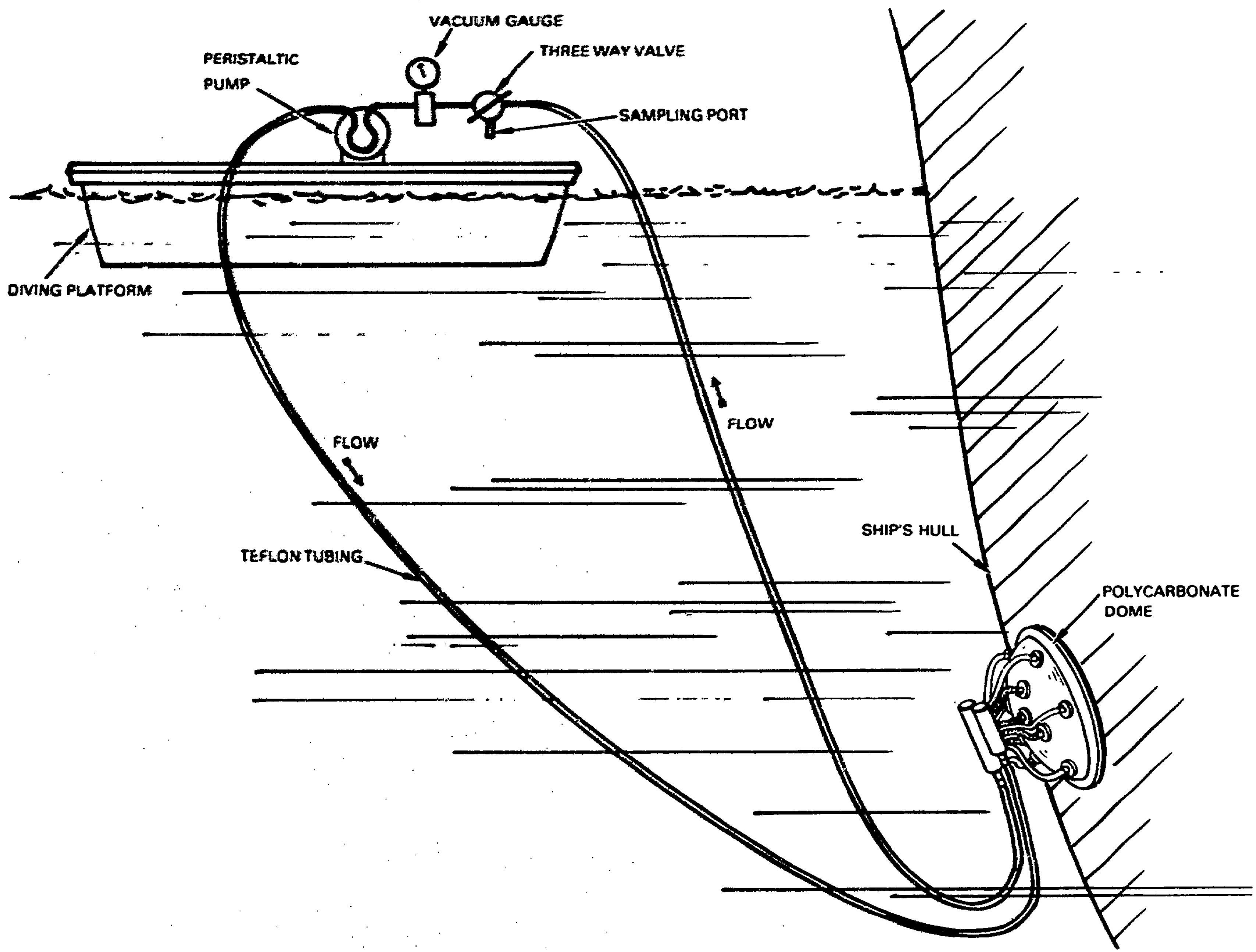


Figure 1. Schematic of in situ leach rate measurement system.

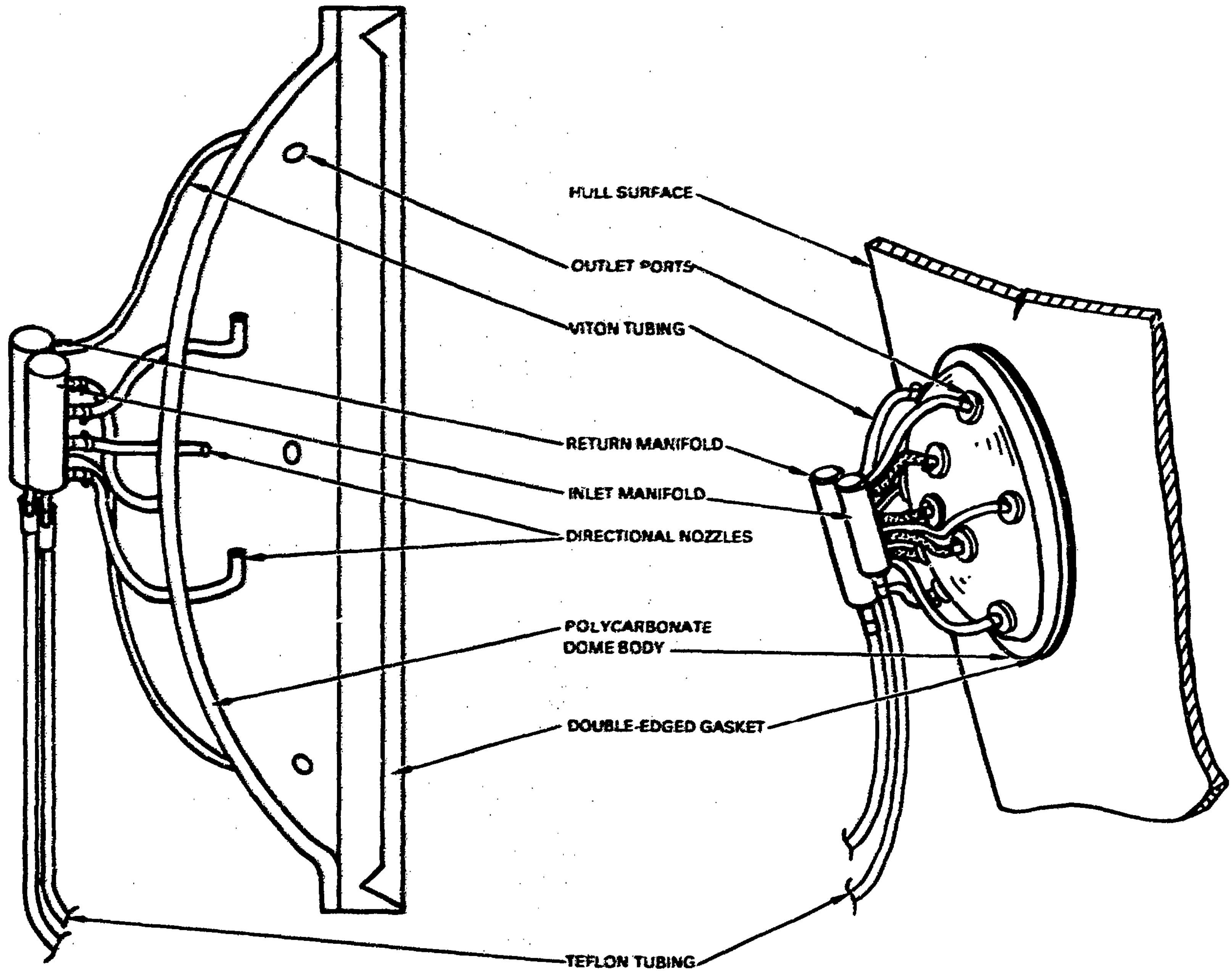


Figure 2. Schematic of polycarbonate dome and manifold system.

Figure 3. Photograph of dome (top view).

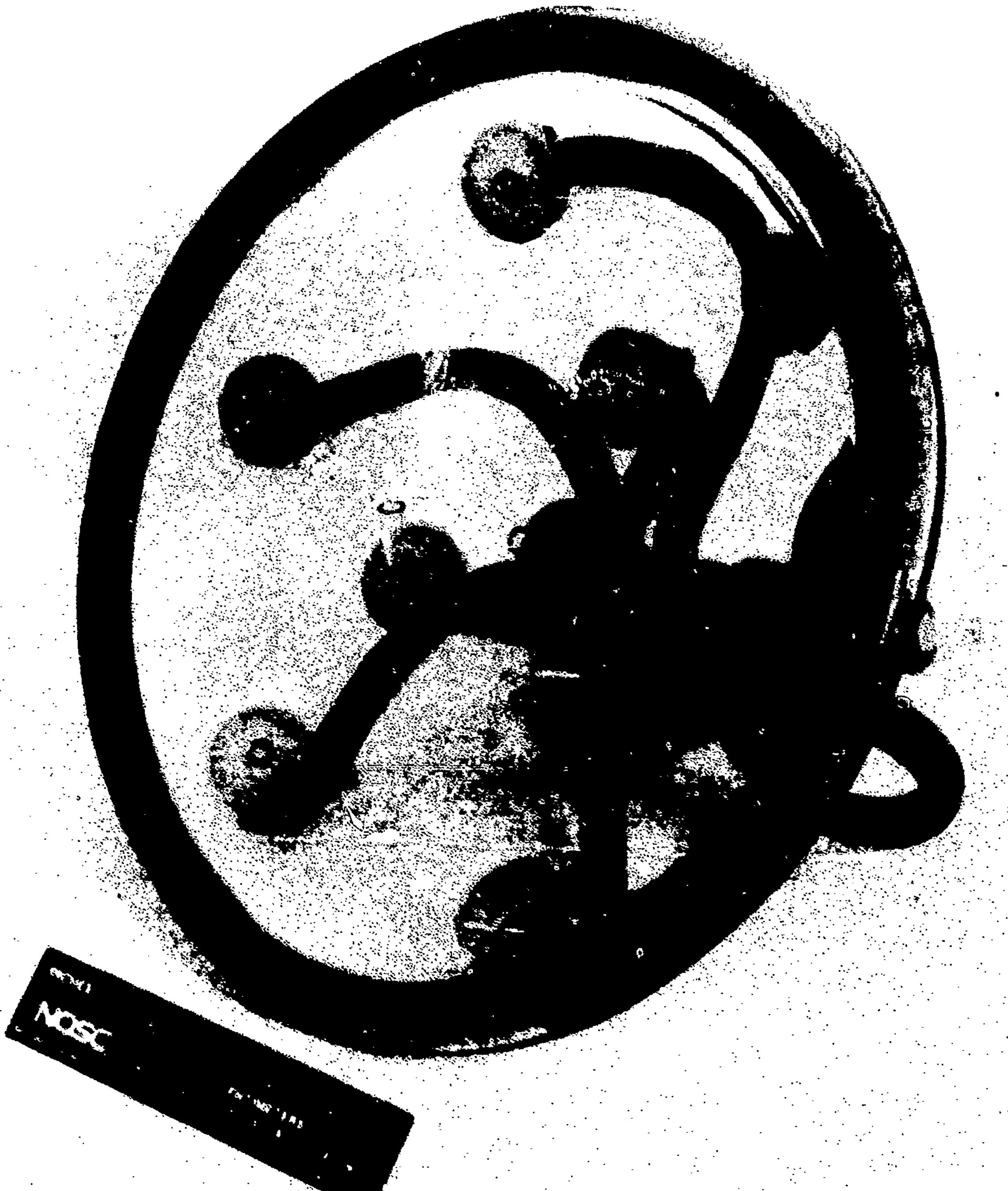


Figure 4. Photograph of dome (bottom view) showing double-edged gasket.

gasket against the hull at a selected sampling location on the hull. A volume of water is then pumped from the closed system until a sufficient vacuum is established to hold the dome in place. The actual vacuum is monitored using an in-line vacuum gauge. The volume of water in the system is recirculated using a flow rate maintained at approximately 525 ml/min. Ten to twenty ml samples are withdrawn from the system every 10 minutes, and the samples are placed on ice until they can be transferred to a refrigerator. Normally, three color-coded (red, yellow, and green) dome systems are used at each sampling site to produce triplicate sample sets.

LABORATORY LEACH RATE DETERMINATIONS

Two steel panels coated with ABC-2 were used to make independent leach rate determinations. One of the panels was removed from the USS KITTY HAWK after 25 months of exposure, and the second test panel had been exposed to San Diego Bay water for 12 months. Determinations were conducted in polycarbonate aquaria filled with 14 L of unfiltered Point Loma seawater and immersed in a flow-through seawater trough to control temperature during the experiment. After a baseline sample was collected, a panel was immersed in each aquarium, and constant gentle circulation was maintained using three air stones in each tank. A sample was removed with a 10-ml volumetric pipette every 10 minutes for 1 hour.

ORGANOTIN ANALYSES

The organotin concentration in each sample collected from either the in situ system or the laboratory system was determined using graphite furnace atomic absorption spectroscopy (AAS) after methylisobutlyketone (MIBK) extraction. Details of this method have already been described (Homer and Dooley, 1983). Concentrations were calculated against an organotin standard (Chemplex Spectrostandard) prepared (weight per volume) in MIBK.

Single samples from selected leach rate determinations were also analyzed by hydride reduction coupled with AAS detection to determine the distribution of organotin in the leachate as the tributyl-, dibutyl-, and monobutyltin species. The technique is based on the method originally described by Hodge, Seidel, and Goldberg (1979). Optimization of the method for analysis of tributyltin has been described by Valkirs, Vafa, Seligman, Lieberman, and Stang (1985).

LEACH RATE CALCULATIONS

The organotin emission rate (leach rate) was calculated from the increase in tin measured in the system as a function of time. The total tin in the system at each sampling time was calculated by multiplying the total volume of the system by the concentration of tin determined by AAS. The volume of water within each system varied by as much as 200 ml, depending on how much water was expelled when the initial vacuum was established. Consequently, calibration curves were generated for each system to relate the observed vacuum gauge reading to the volume of water expelled (Figure 5). This permits accurate determination of the total volume of the system for each determination. Reported leach rate values for each paint system were obtained by pooling the data from the three domes at each sample site. The slope from the regression of the pooled data set of tin versus time was used to calculate the leach rate.

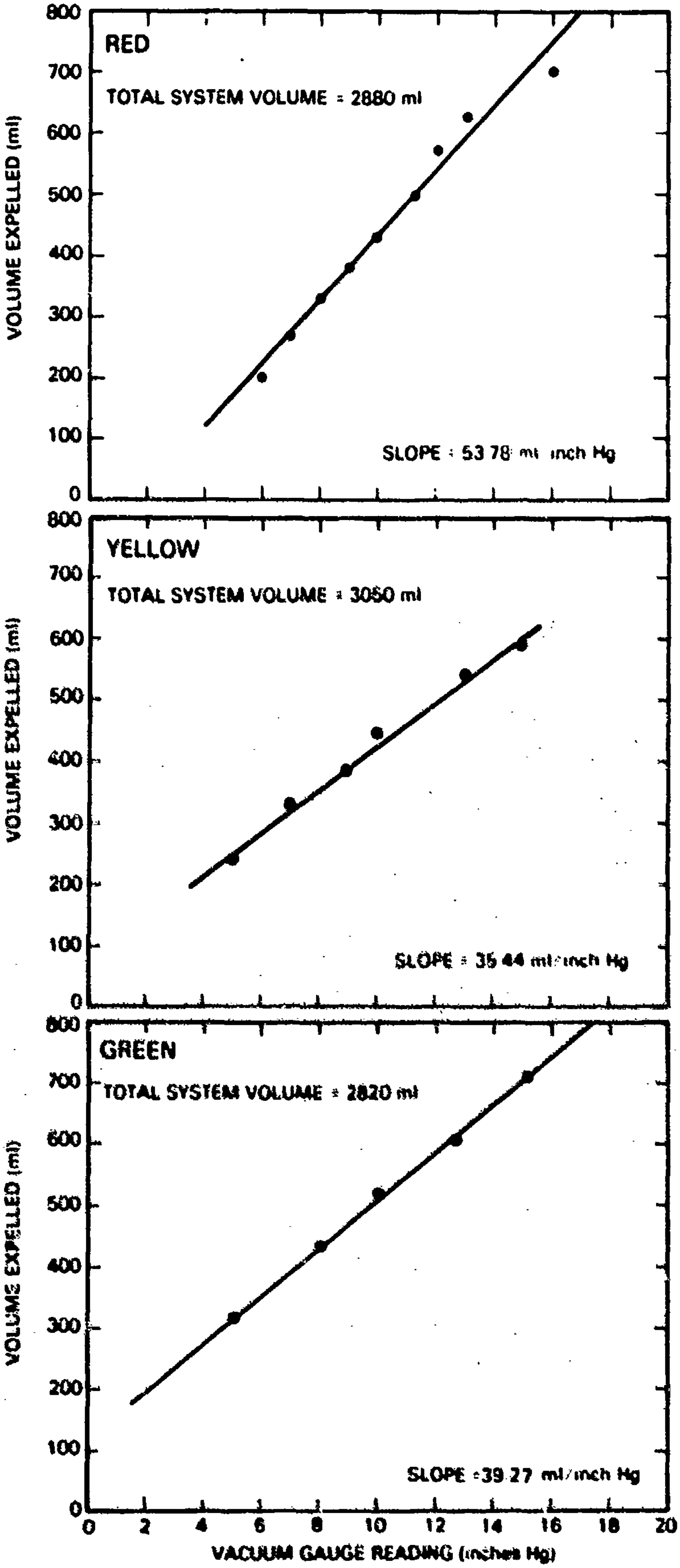


Figure 5. Calibration curves of volume of seawater expelled from dome versus measured vacuum.

The code for the basic program used to generate the plots of tin versus time and to calculate leach rate values and the 95-percent confidence limits of the estimate is listed in Appendix A. A representative plot of tin versus time for a pooled data set is shown in Figure 6. Individual plots of tin versus time for the three domes at the same sampling location often produced different y-intercepts even though the slopes were similar (e.g., Figures 7a, 7b, and 7c). Consequently, all data were normalized to a y-intercept of zero prior to pooling the data from any sample location.

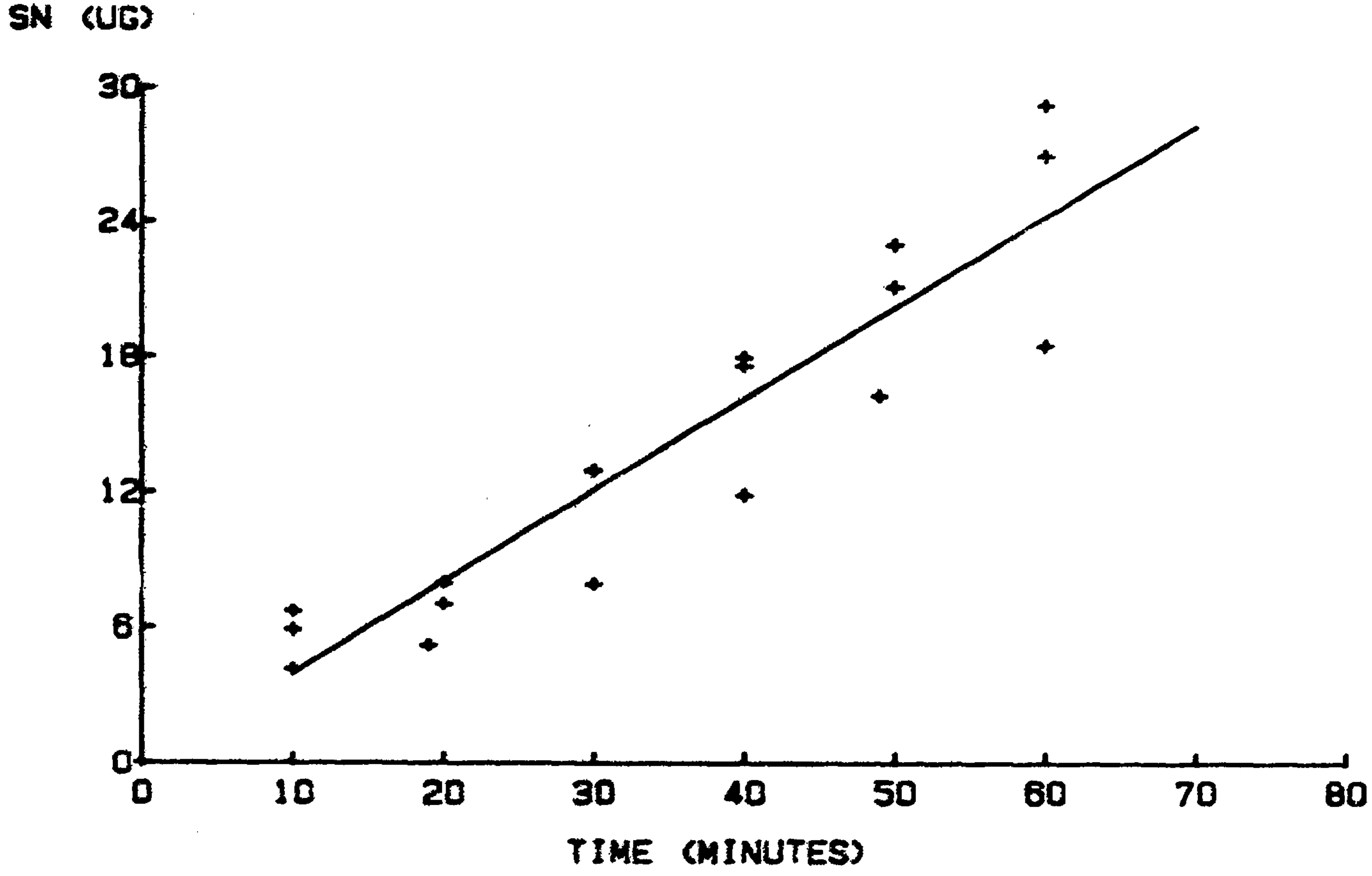
Differences in initial concentrations for different domes may depend on how much the slime layer on the paint surface is disturbed when the dome is placed on the hull. Disturbance of the slime layer is suggested by the fact that the sample collected at time T=0 often showed somewhat elevated tin concentrations. Consequently, the first sample was not included in the regression analyses. Because the leach rate depends only on the rate of increase of tin within the closed system over time, differences in the initial concentration within the system do not affect the final result. This is illustrated in Figures 7a, 7b, and 7c where the three determinations showed different initial concentrations but similar slopes. Comparisons showed the mean leach rate calculated from three separate determinations at each sample site was nearly identical to that obtained by pooling the normalized data. The pooled data, however, permits a better statistical estimate of the overall variability of each determination. Reported values are expressed in terms of the 95-percent confidence limits calculated from the confidence limits on the regression coefficient of the pooled data (Sokal and Rohlf, 1969).

ANCILLARY MEASUREMENTS

Temperature and pH were also measured near each ship hull using a Horiba Model U-7 Water Quality Checker equipped with a cable that permitted the sensor to be lowered to a maximum depth of 10 m. Manufacturer's specifications state the measurement precision for the instrument is ± 0.1 pH units and ± 0.5 degrees Centigrade. In seawater, the accuracy of the pH measurement is probably not much better than ± 0.2 pH units because of problems associated with standardization in a high-ionic strength medium.

SHIP: USS MEYERKORD   DATE: 14 AUG 84

PAINT SYSTEM: OMP M5211F   STATION: A/POOLED DATA



SLOPE= .4058672   INTERCEPT=-8.858914E-02   R2= .8538178

LEACH RATE= 2 UG TBTO/CM2/DAY   95% CL= 22 %   POINTS EXCLUDED= 0

Figure 6. Plot of tin versus time for th- OMP M5211F paint system on the USS MEYERKORD (pooled data set).

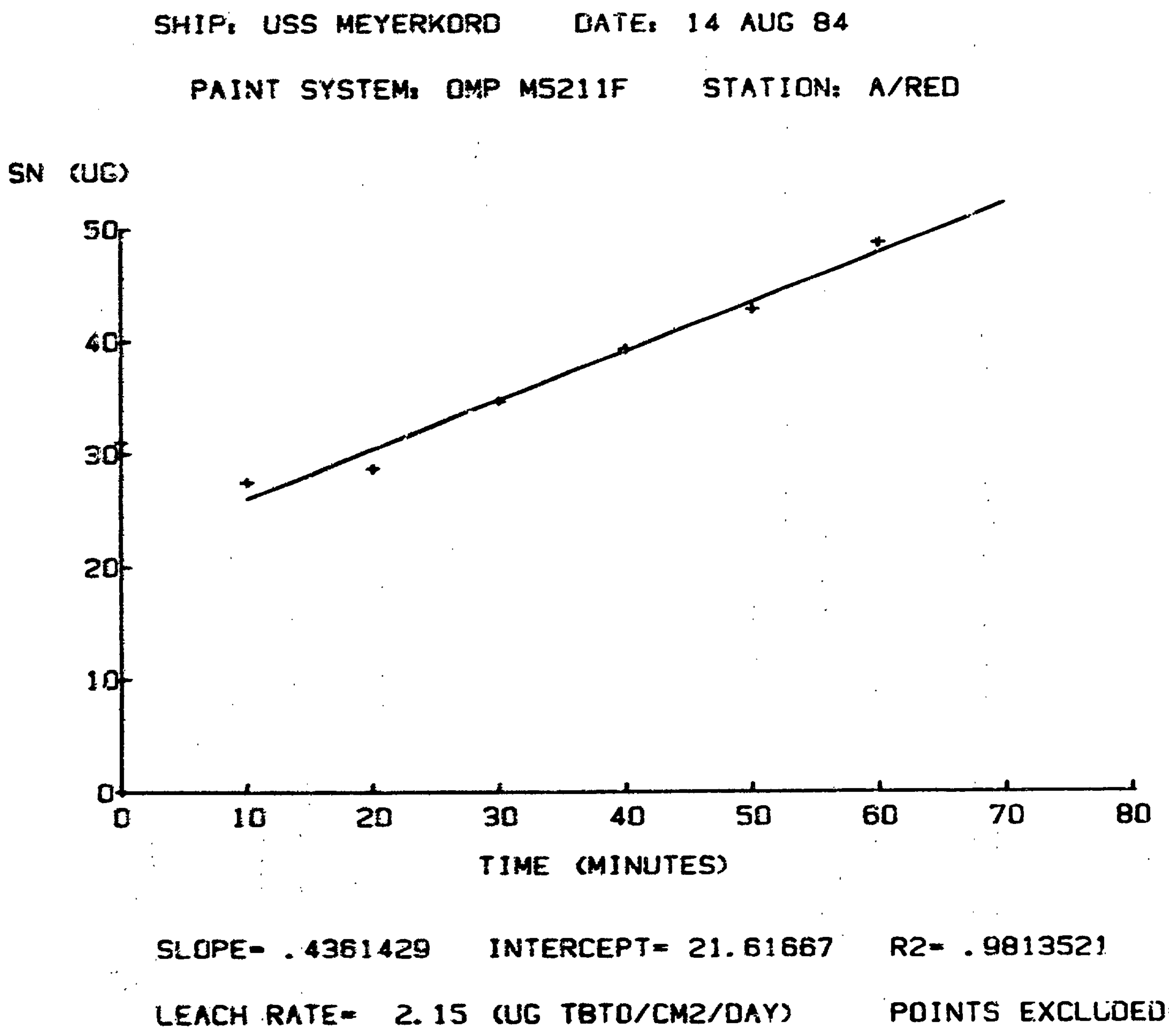


Figure 7a. Plot of tin versus time for the OMP M5211F paint system on the USS MEYERKORD (red dome system).

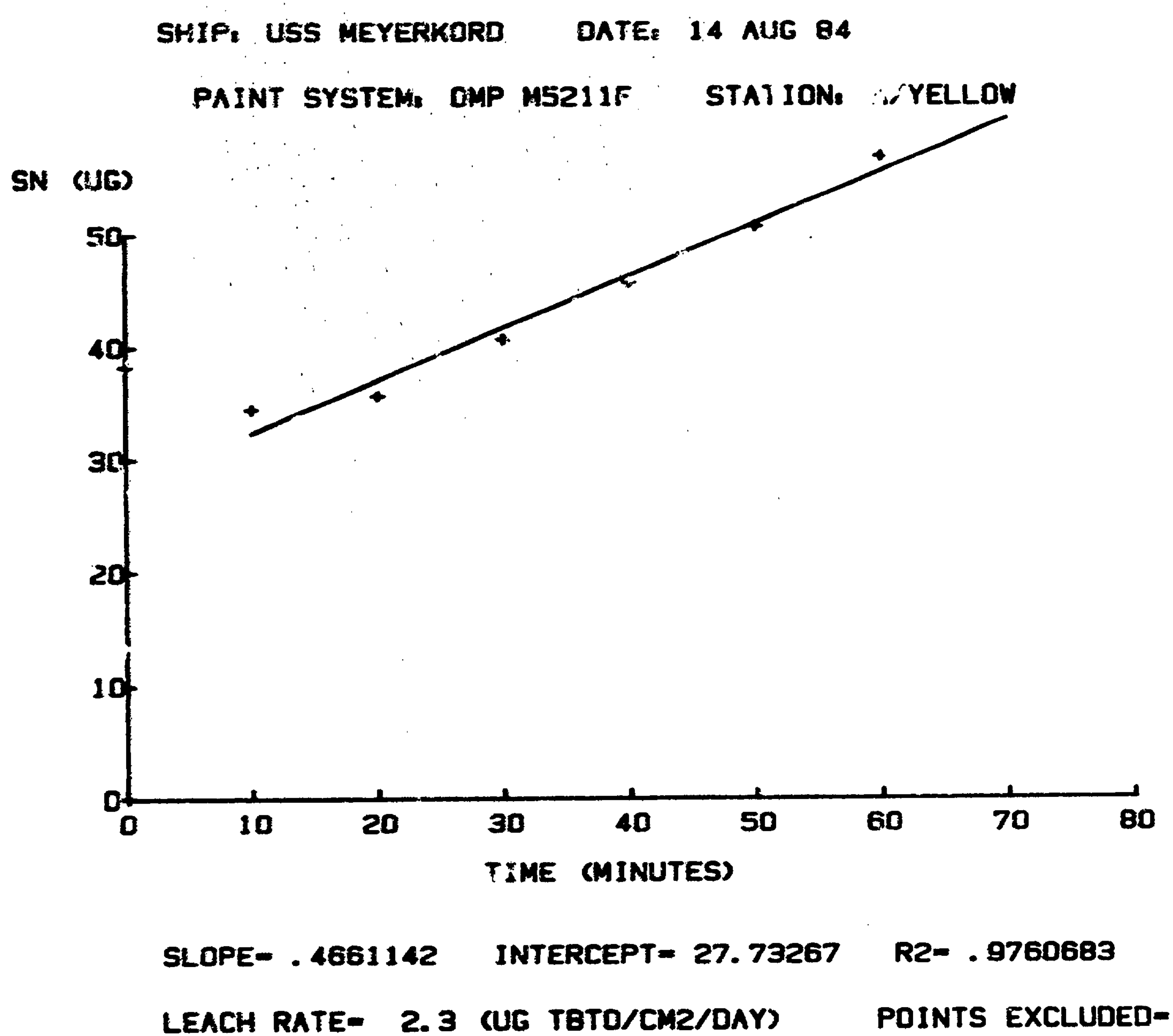
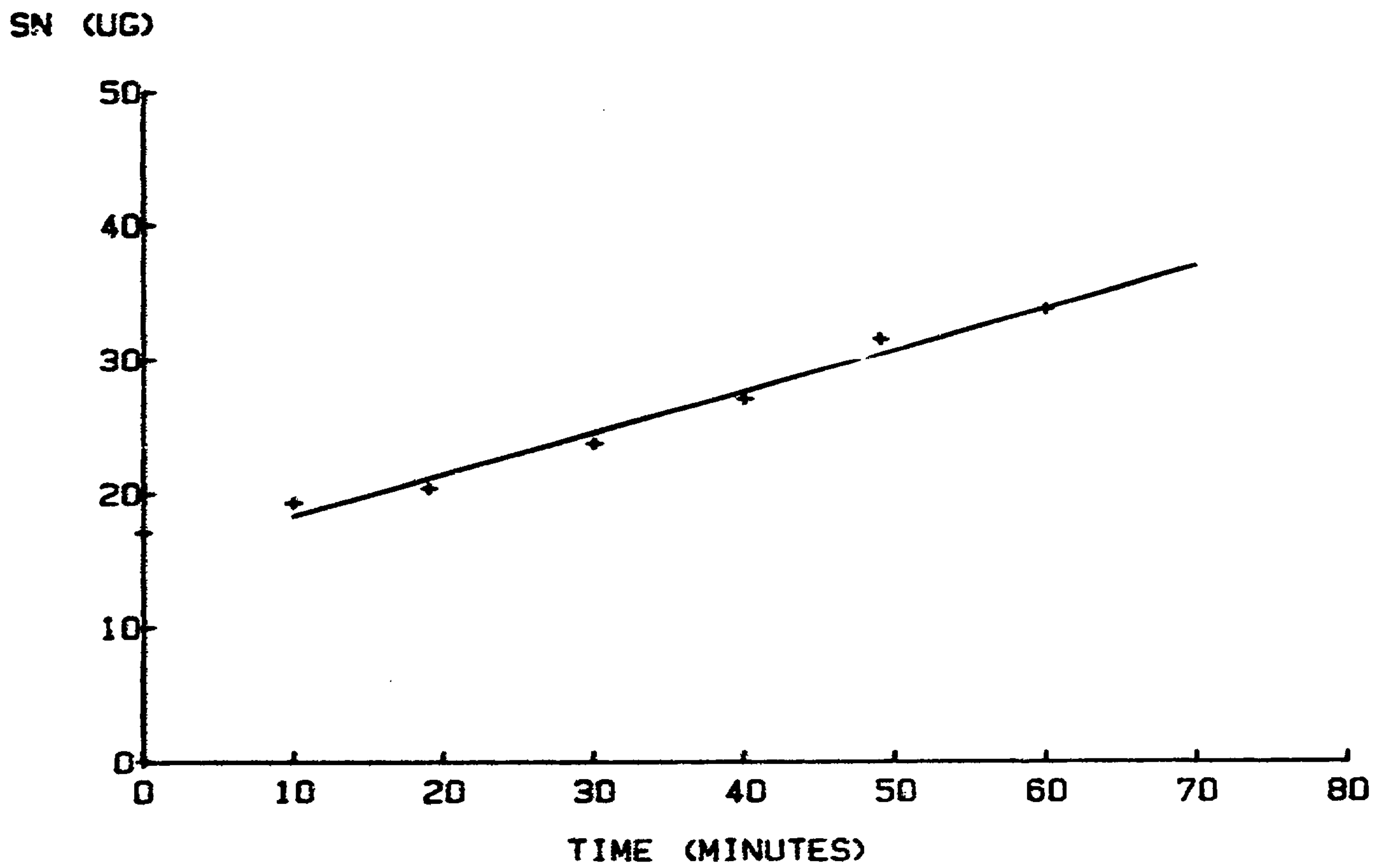


Figure 7b. Plot of tin versus time for the OMP M5211F paint system on the USS MEYERKORD (yellow dome system).

SHIP: USS MEYERKORD   DATE: 14 AUG 84

PAINT SYSTEM: OMP M5211F   STATION: A/GREEN



SLOPE= .3099144   INTERCEPT= 15.17797   R2= .9789386

LEACH RATE= 1.53 (UG TBTO/CM2/DAY)   POINTS EXCLUDED= 1

Figure 7c. Plot of tin versus time for the OMP M5211F paint system on the USS MEYERKORD (green dome system).

RESULTS AND DISCUSSION

Table 1 summarizes the results of in situ leach rate measurements conducted in Norfolk on the USS CORAL SEA (CV 43) and the USS BIRMINGHAM (SSN 695) during July 1984, in Long Beach on the USS MEYERKORD (FF 1050) during August 1984, and in San Diego on the MEYERKORD during December 1984. Except where noted, reported values are the result of normalizing and pooling the data from three separate determinations at each sample site. Values are expressed in terms of the 95-percent confidence limit of the estimate. Plots of individual determinations from each dome and plots of the pooled data set for each paint system are presented in Appendix B. Table 1 shows the measured leach rates ranged from a low of 0.18 to a high of 3.2 $\mu g/cm^2/day$. The SPC-254 coating on the CORAL SEA showed the lowest leach rate with a mean value of 0.24 ± 0.05 $\mu g/cm^2/day$ for the five areas investigated. The OMP M5211S coating on the MEYERKORD showed the highest value. Note, however, the value for the OMP M5211S paint system does not appear to be significantly different from the other OMP systems or the ABC-2 coating on the BIRMINGHAM.

Laboratory studies have shown that the leach rate of certain paint systems is a function of pH and temperature (Adema and Jackson, 1982). Considerable differences in pH and temperature were observed in the ambient water where these measurements were conducted. The pH ranged from a low of 7.4 in the brackish waters of Norfolk Naval Shipyard to a high of 8.4 in the warm saline waters of Long Beach Naval Shipyard. Measurements conducted in San Diego Bay in December on the MEYERKORD were done at intermediate pH values and relatively low ambient temperatures. Based on the limited set of data presented here, observed differences in leach rates (e.g., measurements conducted on the same paint systems on the MEYERKORD during August in Long Beach and during December in San Diego) could not be solely related to pH and temperature effects. The authors believe that part of the reason no clear trends are evident with regard to pH and temperature differences is that under environmental settings the micro environment created by the slime layer on the hull may actually regulate the pH in the vicinity of the hull-water interface. In addition, the ship's movement from Long Beach to San Diego may have altered the slime layer on the paint surface and caused variances in the measured leach rates. The authors plan to continue to document the pH and temperature of the ambient water as more measurements are made to attempt to resolve the effect of environmental differences in pH and temperature on leach rates for different paint systems.

Based on the measurements made to date, the in situ leach rate technique used in this study appears to provide an accurate, reliable method for determining organotin release rates from ship hulls under realistic environmental conditions. Inspection of the individual plots of tin versus time (three of which are presented in Figures 7a, 7b, and 7c) shows the increase in tin concentration is, in general, highly linear between 10 and 60 minutes with R^2 values of greater than 0.95 in 28 of the 33 measurements made in July and August of 1984. Although no direct comparisons were made on a single panel, laboratory measurements made to confirm the greater than expected values for the ABC-2 paint system (Table 2) produced results similar to those obtained using the in situ system.

Table 1. Summary of in situ leach rate determinations of several organotin antifouling coatings.

Ship/Date	Paint System	Depth (ft)	Leach Rate* ($\mu gTBT/cm^2/day$)	Temp (deg C)	pH
MEYERKORD/Aug 84	ABC-2	3	$0.80 \pm 21\%$	24.1	8.4
MEYERKORD/Aug 84	ABC-2	9	$0.70 \pm 7\%$	23.8	8.4
MEYERKORD/Dec 84	ABC-2	6	$0.33 \pm 26\%$	16.0	7.8
BIRMINGHAM/Jul 84	ABC-2	10	$2.3 \pm 31\%$	NR	NR
MEYERKORD/Aug 84	OMP M5211F	3	$2.0 \pm 22\%$	24.1	8.4
MEYERKORD/Dec 84	OMP M5211F	6	$1.6 \pm 12\%$	16.0	7.8
MEYERKORD/Aug 84	OMP M5211S	3	$2.4 \pm 28\%$	24.1	8.4
MEYERKORD/Dec 84	OMP M5211S	6	$3.2 \pm 21\%$	16.0	7.8
MEYERKORD/Aug 84	OMP 58S	3	$1.7 \pm 18\%$	24.1	8.4
MEYERKORD/Dec 84	OMP 58S	6	$0.72 \pm 4\%$ @	16.0	7.8
MEYERKORD/Aug 84	SPC-4	3	$0.40 \pm 24\%$	24.1	8.4
MEYERKORD/Dec 84	SPC-4	6	$1.7 \pm 22\%$	16.0	7.8
CORAL SEA/Jul 84	SPC-254	15	$0.31 \pm 44\%$	26.2	7.5
CORAL SEA/Jul 84	SPC-254	5	$0.28 \pm 22\%$ #	26.4	7.5
CORAL SEA/Jul 84	SPC-254	10	$0.21 \pm 20\%$ #	26.3	7.5
CORAL SEA/Jul 84	SPC-254	5	$0.18 \pm 15\%$ #	26.4	7.5
CORAL SEA/Jul 84	SPC-254	5	$0.22 \pm 31\%$ #1	26.4	7.5

* $\pm$ 95% confidence limit

@ value based on measurements from only one system

\# value based on measurements from only two systems

1 slime layer removed

NR not recorded

Table 2. Summary of in situ and laboratory-determined leach rates for ABC-2 antifouling coating.

Method	Ship/Panel	Leach Rate* (gTBT/cm^2/day)	Temp (deg C)	pH
In situ - USS MEYERKORD				
	Aug 1984	0.80±20%	24.1	8.4
	Aug 1984	0.70±7%	24.1	8.4
	Dec 1984	0.33±26%	16.0	7.8
In situ - USS BIRMINGHAM				
	July 1984	2.3±31%	NR	NR
Laboratory - USS KITTY HAWK				
	Aug 1984	3.3±14%#	22	8.3
	Dec 1984	1.7±19%	17	NR
Laboratory - San Diego Bay		2.8±40%	21	8.0

* ±95% confidence limits
NR not recorded
\# value based on measurements from only two systems

An attempt was made to determine whether removal of the slime layer before the dome was placed on the hull made a significant difference in the rate of toxicant release from the hull of the CORAL SEA. Because of time constraints and other shipyard activities, only one set of samples was collected with the slime layer removed. Results suggest that removal of the slime layer did not change the leach rate determined for the 3-month-old AF system.

Results of hydride-AAS determinations of the monobutyl-, dibutyl-, and tributyltin in the leachate are presented in Table 3. Although the results must be considered preliminary because of the limited number of samples analyzed to date, there appears to be a significant difference in the quantity of dibutyltin present in the leachate from the different paint systems. Measurements of the ABC-2 paint system on the MEYERKORD and on a test panel show the dibutyltin component ranged from 13 to 38 percent with a mean of 28 percent for the eight samples measured. In contrast, leachates from the SPC and OMP paint systems did not contain any measurable quantities of di- or monobutyltin. It is not clear at present whether these differences represent a dibutyltin impurity in the ABC-2 paint or some difference in the degradation of the tributyltin for the different paint systems. Because leach rates were calculated assuming all tin extracted by MIBK was in the form of tributyltin, hydride measurements indicated that ABC-2 values may be overestimated by an amount up to the fraction of tin present as dibutyltin. These results demonstrate why organotin speciation information is important to properly evaluating the behavior of these compounds in the environment.

Table 3. Percent monobutyl-, dibutyl- and tributyltin in leachate determined by the hydride-AAS technique.

Paint System/Ship or Panel	MBT	DBT (percent)	TBT	Total Sn (μg/L)
ABC-2/MEYERKORD (Aug 84)	NM	38	62	5.4
	NM	38	62	4.6
	NM	34	66	6.8
	NM	35	65	8.6
	NM	13	87	7.7
	NM	19	81	5.7
ABC-2/Panel	NM	18	84	9.7
	NM	26	74	5.0
SPC 254/CORAL SEA (July 84)	NM	NM	100	1.8
	NM	NM	100	3.8
OMP M58S/MEYERKORD (Aug 84)	NM	NM	100	6.3
	NM	NM	100	6.6
	NM	NM	100	6.9

NM = below detection limit of 0.01 μg/L

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Sokal, R. R. and F. J. Rohlf (1969). Biometry. W. H. Freman and Company, San Francisco: 776 pp.

Valkirs, A., G. Vafa, P. F. Seligman, S. H. Lieberman, and P. Stang (1985). Speciation of butyltins and methyltins in seawater and marine sediments by hydride derivatization and atomic absorption detection. (NOSC Tech. Rep. 1037) San Diego: Naval Ocean Systems Center.

APPENDIX A

BASIC PROGRAM FOR PLOTTING AND CALCULATING LEACH RATE DATA

```
10 REM PROGRAM TINPLOT
20 REM   THIS PROGRAM PLOTS TIN LEACH RATE DATA FROM NON-DOCUMENT
30 REM          FILES CREATED WITH WORDSTAR, THE DATA IS THEN REGRESSED,
40 REM          THE LEACH RATE IS CALCULATED AND THE 95% CONFIDENCE
50 REM          LIMITS OF THE ESTIMATE IS CALCULATED FROM THE CONFIDENCE
60 REM          LIMITS OF THE REGRESSION COEFFICIENT
70 REM
80 REM  GRAPHICS COMANDS FOR PLOTTING THE DATA ARE FOR A HP7470A PLOTTER
90 REM
100 REM  PROGRAM REVISED 11 JAN 85   S.H.LIEBERMAN
110 REM
120 OPEN "COM1:9600,N,7,1" AS #1
130 INPUT "INPUT NAME OF FILE CONTAINING DATA (EG.,B:TINDATA) "  ,F$
140 OPEN "I",#2,F$
150 REM OPEN COMMUNICATION PORT BETWEEN COMPAQ AND PLOTTER
160 INPUT #2,S$,P$,SY$,D$
170 PRINT S$,P$,SY$,D$
180 REM OPEN FILE CONTAINING LEACH RATE DATA
190 INPUT "INPUT YMIN AND YMAX FOR PLOT (EG.,YMIN,YMAX)  ",YMIN,YMAX
200 INPUT "INPUT NUMBER OF INITIAL POINTS TO SKIP FOR REGRESSION ", NS
210 PRINT #1, "IN;"
220 PRINT #1,"DT"CHR$(3)
230 PRINT #1, "VS;"
240 REM DRAW AND LABEL AXES ON PLOT
250 PRINT #1, "SM;"
260 PRINT #1,"IP1200,1800,7400,5500;SP1;"
270 PRINT #1,"SC0,80,"YMIN,YMAX";"
280 PRINT #1,"TL1.5,0;"
290 PRINT #1,"SI.19,.27;"
300 PRINT #1,"PA0,"YMIN";"
310 FOR X=0 TO 80 STEP 10
320 PRINT #1, "PD;"
330 FOR J=1 TO 200: NEXT J
340 PRINT #1,"PD;PA",X,YMIN";PU;XT;"
350 IF X>=10 THEN 380
360 PRINT #1,"CP-1.33,-1;"
370 IF X<=9 THEN 390
380 PRINT #1,"CP-1.835,-1;"
390 PRINT #1,"LB";X;CHR$(3)
400 PRINT #1," ;PA",X,YMIN";"
410 NEXT X
420 PRINT #1,"TL1,"YMIN";"
430 PRINT #1,"PA0,"YMIN ";"
440 S=(YMAX-YMIN)/5
450 FOR Y=YMIN TO YMAX STEP S
460 PRINT #1, "PD;PA0,",Y,";PU;YT;"
470 IF Y>=100 THEN PRINT #1, "CP-3.57,-.25;":GOTO 500
480 IF Y>=10 THEN PRINT #1, "CP-2.9,-.25;":GOTO 500
490 PRINT#1, "CP-2.23,-.25;"
500 PRINT #1, "LB";Y;CHR$(3)
510 FOR J=1 TO 300:NEXT J
520 PRINT #1, " ;PA0,",Y
530 NEXT Y
540 PRINT #1, "PA0,"YMAX";CP-6,1.5;"
550 PRINT #1, "LBSN (UG)";CHR$(3)
560 PRINT #1, "PA0,"YMAX";CP60,0;"
570 PRINT #1, "LBFILE# ";F$;CHR$(3)
580 FOR J=1 TO 1000: NEXT J
590 PRINT #1, "PA0,"YMAX";CP2,6;"
600 PRINT #1, "LBSHIP: ";S$;"    DATE: ";D$;CHR$(3)
610 FOR J=1 TO 3000: NEXT J
620 PRINT #1, "PA0,"YMAX";CP4,4;"
630 PRINT #1, "LBPAINT SYSTEM: ";P$;"    STATION: ";SY$;CHR$(3)
640 FOR J=1 TO 3000: NEXT J
```

```
650 PRINT #1, "PA40,"YMIN";CP-8,-2.5;"
660 PRINT #1, "LBTIME (MINUTES)";CHR$(3)
670 INPUT"FINISHED WITH AXES -STRIKE ANY KEY TO CONTINUE",Z$
680 PRINT #1, "LTO;"
690 PRINT #1, "SM+;"
700 REM PLOT DATA
710 ON ERROR GOTO 800
720 INPUT #2,X,Y
730 PRINT "Y=",Y
740 PRINT #1, "PA";X;Y;"PD"
750 FOR J=1 TO 200: NEXT J
760 GOTO 720
770 PRINT "RETURNING TO CLOSE FILE"
780 CLOSE #2
790 PRINT #1, "PU;PA0,"YMIN";"
800 PRINT ERR
810 IF ERR=62 THEN RESUME 770
820 ON ERROR GOTO 0
830 REM REGRESSION ROUTINE
840 PRINT "REGRESS DATA"
850 OPEN "I",#2,F$
860 ON ERROR GOTO 1510
870 N=0
880 AX=0
890 AY=0
900 SXS=0
910 SYS=0
920 SSX=0
930 SSY=0
940 N=0
950 SX=0
960 SY=0
970 SXY=0
980 INPUT#2 ,S$,P$,SY$,D$
990 INPUT#2, X,Y
1000 REM CALCULATE N, SUM OF X(SX), SUM OF Y(SY)
1010 REM   "       THE SUM OF X AND SUM OF Y SQUARED ,(SXS),(SYS)
1020 REM   "             "      " XY (SXY)
1030 N=N+1
1040 IF N<=NS GOTO 990
1050 PRINT X,Y
1060 SX=SX+X
1070 SY=SY+Y
1080 SXS=SXS+X^2
1090 SYS=SYS+Y^2
1100 SXY=SXY+(X*Y)
1110 GOTO 990
1120 REM CALCULATE AVRG.OF X(AX) AND OF Y (AY)
1130 REM   "       SQUARE OF THE SUM OF X AND OF Y ,(SSX),(SSY)
1140 N=N-NS
1150 PRINT "N=",N,"SX=",SX,"SY=",SY,"SXS=",SXS,"SYS=",SYS,"SXY=",SXY
1160 AX=SX/N
1170 AY=SY/N
1180 SSX=SX^2
1190 SSY=SY^2
1200 A=SYS-(SY^2/N)
1210 B=SXS-(SX^2/N)
1220 C=SXY-((SX*SY)/N)
1230 REM CALCULATE 95% CONFIDENCE LIMITS
1240 SE=SQR(((A-((C*C)/B))/(N-2))/B)
1250 IF N-2=17 THEN TDIST=2.11
1260 IF N-2=16 THEN TDIST=2.12
1270 IF N-2=15 THEN TDIST=2.131
1280 IF N-2=14 THEN TDIST=2.145
1290 IF N-2=13 THEN TDIST=2.16
1300 IF N-2=12 THEN TDIST=2.179
```

```
1310 IF N-2=11 THEN TDIST=2.201
1320 IF N-2=10 THEN TDIST=2.228
1330 IF N-2=9 THEN TDIST=2.262
1340 IF N-2=8 THEN TDIST=2.306
1350 IF N-2=7 THEN TDIST=2.365
1360 IF N-2=18 THEN TDIST=2.101
1370 IF N-2=6 THEN TDIST=2.447
1380 IF N-2=5 THEN TDIST=2.571
1390 IF N-2=4 THEN TDIST=2.776
1400 IF N-2=3 THEN TDIST=3.182
1410 IF N-2=2 THEN TDIST=4.303
1420 CL=TDIST*SE
1430 PRINT ""
1440 PRINT ""
1450 SLOPE=((N*SXY)-(SX*SY))/((N*SXS)-SSX)
1460 INTERCEPT=(SY-(SLOPE*SX))/N
1470 R=((N*SXY)-(SX*SY))/(((SXS*N)-SSX)*((N*SYS)-SSY))^.5
1480 R2=R^2
1490 PRINT "SLOPE=",SLOPE,"INTRCEPT=",INTERCEPT,"R=",R,"R2=",R2
1500 CLOSE#2
1510 PRINT ERR
1520 IF ERR=62 THEN RESUME 1120
1530 ON ERROR GOTO 0
1540 PRINT #1, "LT;"
1550 PRINT #1, "SM;"
1560 FOR X=10 TO 70 STEP 10
1570 Y=(SLOPE*X)+INTERCEPT
1580 PRINT #1, "PA",X,Y";PD;"
1590 NEXT X
1600 PRINT #1, "PU;PA0,"YMIN";"
1610 PRINT #1, "CP2,-5;"
1620 PRINT #1, "LBSLOPE=";SLOPE;"  INTERCEPT=";INTERCEPT;"  R2=";R2;CHR$
1630 REM CALCULATE LEACH RATE
1640 REM LR=SLOPE(ug/min) x 60(min/hr) x 24(hr/day) x 1/729.7(cm^2) x 2.5(ug [illegible]
0/ug Sn)
1650 LR=SLOPE*60*24*2.5/729.7
1660 PCL=CL/SLOPE
1670 LRCL=PCL*LR
1680 PLRCL=CINT(LRCL/LR*100)
1690 PRINT "LEACH RATE CONFIDENCE LIMITS", PLRCL
1700 LRI=INT(LR)
1710 RF=(CINT((LR-LRI)*100))/100
1720 LR=LRI+RF
1730 PRINT LR
1740 PRINT #1, "PU;PA0,"YMIN";"
1750 PRINT #1, "CP2,-7;"
1760 PRINT #1, "LBLEACH RATE= ";LR;"UG TBTO/CM2.DAY";"  95% CL= ";LRCL;", [illegible]
IS EXCLUDED  ";HR [illegible]
1770 PRINT #1, "PU;PA0,"YMIN";"
1780 END
```

APPENDIX B

PLOTS OF TIN VERSUS TIME FOR INDIVIDUAL LEACH RATE DETERMINATIONS AND FOR POOLED DATA

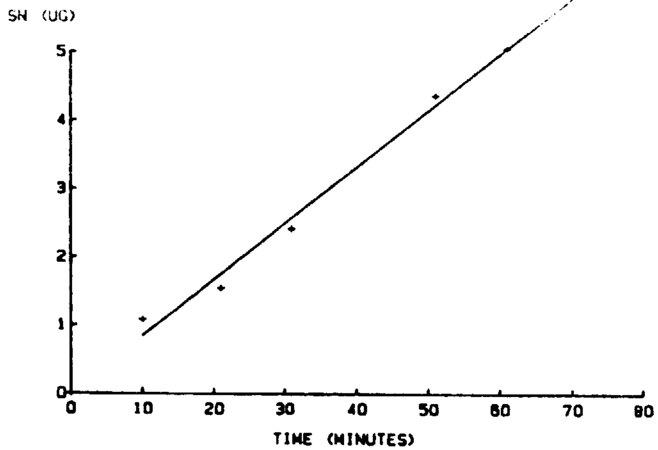
Figure	Ship	Paint	Dome	Survey Date
B-1	CORAL SEA	SPC 254	Red	7-9-84
B-2	"	"	Yellow	"
B-3	"	"	Green	"
B-4	"	"	Pooled	"
B-5	CORAL SEA	SPC 254	Red	7-9-84
B-6	"	"	Green	"
B-7	"	"	Pooled	"
B-8	CORAL SEA	SPC 254	Red	7-10-84
B-9	"	"	Green	"
B-10	"	"	Pooled	"
B-11	CORAL SEA	SPC 254	Red*	7-10-84
B-12	"	"	Yellow	"
B-13	"	"	Green	"
B-14	"	"	Pooled	"
B-15	CORAL SEA	SPC 254	Red*	7-10-84
B-16	"	"	Green*	"
B-17	"	"	Pooled	"
B-18	BIRMINGHAM	ABC-2	Red	7-11-84
B-19	"	"	Yellow	"
B-20	"	"	Green	"
B-21	"	"	Pooled	"
B-22	MEYERKORD	ABC-2	Red	8-14-84
B-23	"	"	Yellow	"
B-24	"	"	Green	"
B-25	"	"	Pooled	"
B-26	MEYERKORD	ABC-2	Red	8-15-84
B-27	"	"	Yellow	"
B-28	"	"	Green	"
B-29	"	"	Pooled	"
B-30	MEYERKORD	OMP 58S	Red	8-14-84
B-31	"	"	Yellow	"
B-32	"	"	Green	"
B-33	"	"	Pooled	"
B-34	MEYERKORD	SPC-4	Red	8-14-84
B-35	"	"	Yellow	"
B-36	"	"	Green	"
B-37	"	"	Pooled	"
B-38	MEYERKORD	OMP M5211F	Red	8-14-84
B-39	"	"	Yellow	"
B-40	"	"	Green	"
B-41	"	"	Pooled	"
B-42	MEYERKORD	OMP 5211S	Red	8-15-84
B-43	"	"	Yellow	"
B-44	"	"	Green	"
B-45	"	"	Pooled	"
B-46	MEYERKORD	ABC-2	Red	12-11-84
B-47	"	"	Yellow	"
B-48	"	"	Green	"
B-49	"	"	Pooled	"

*Slime layer removed

Figure	Ship	Paint	Dome	Survey Date
B-50	MEYERKORD	OMP 5211F	Red	12-11-84
B-51	"	"	Yellow	"
B-52	"	"	Green	"
B-53	"	"	Pooled	"
B-54	MEYERKORD	OMP 5211S	Red	12-11-84
B-55	"	"	Yellow	"
B-56	"	"	Green	"
B-57	"	"	Pooled	"
B-58	MEYERKORD	SFC-4	Red	12-12-84
B-59	"	"	Yellow	"
B-60	"	"	Green	"
B-61	"	"	Pooled	"
B-62	MEYERKORD	OMP 58S	Red	12-12-84

SHIP: USS CORAL SEA DATE: 9 JULY 84

PAINT SYSTEM: SPC 254 STATION: A/RED



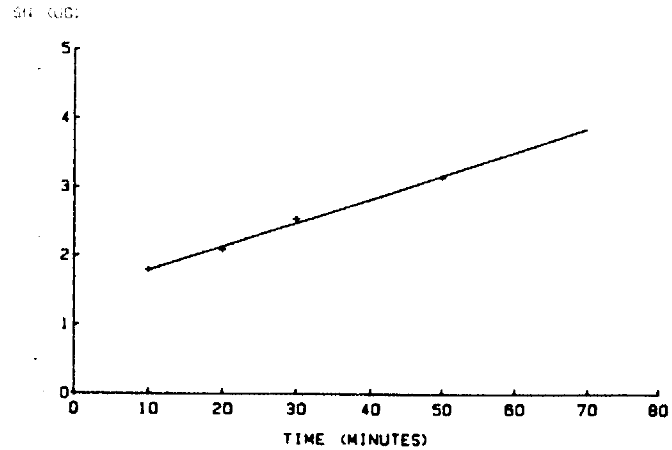
SLOPE= .0821597 INTERCEPT= 2.484228E-02 R2= .9881531

LEACH RATE= .41 (UG TBTO/CM2/DAY) POINTS EXCLUDED= 0

Figure B-1.

SHIP: USS CORAL SEA DATE: 9 JULY 84

PAINT SYSTEM: SPC 254 STATION: A/YELLOW



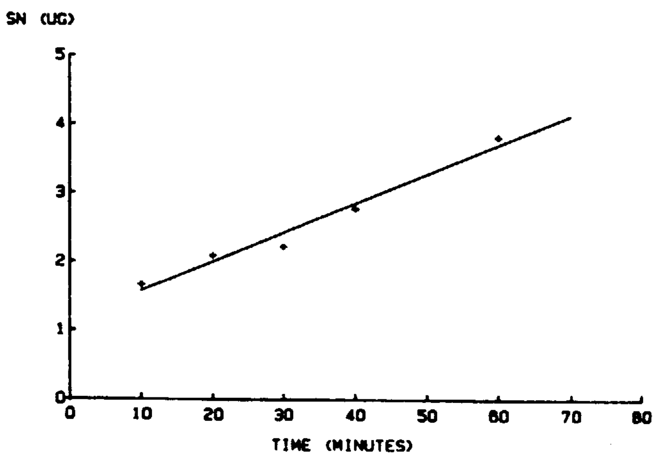
SLOPE= 3.454286E-02 INTERCEPT= 1.442571 R2= .9942681

LEACH RATE= .17 (UG TBTO/CM2/DAY) POINTS EXCLUDED= 0

Figure B-2.

SHIP: USS CORAL SEA DATE: 9 JULY 84

PAINT SYSTEM: SPC 254 STATION: A/GREEN



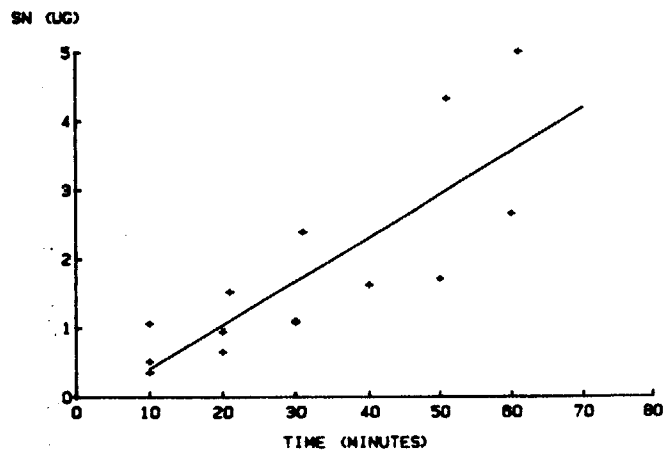
SLOPE= 4.243245E-02 INTERCEPT= 1.152161 R2= .9723263

LEACH RATE= .21 (UG TBTO/CM2/DAY) POINTS EXCLUDED= 0

Figure B-3.

SHIP: USS CORAL SEA DATE: 9 JULY 84

PAINT SYSTEM: SPC 254 STATION: A/POOLED



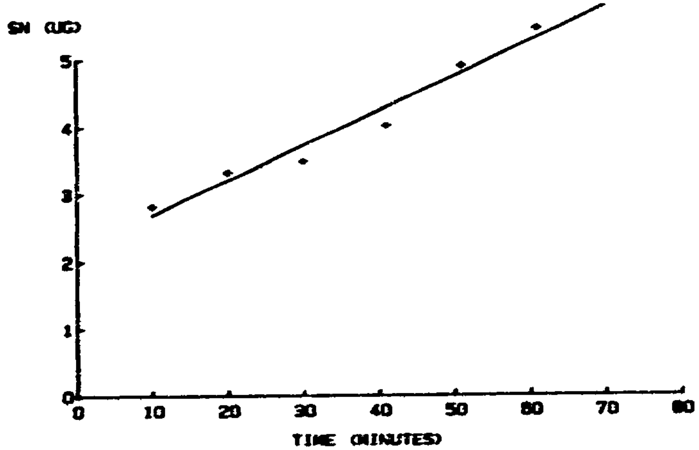
SLOPE= 6.326460E-02 INTERCEPT=-.2256793 R2= .6693645

LEACH RATE= .31 UG TBTO/CM2/DAY 95% CL= 44 % POINTS EXCLUDED= 0

Figure B-4.

SHIP: USS CORAL SEA   DATE: 9 JULY 84

PAINT SYSTEM: SPC 254   STATION: B/RED



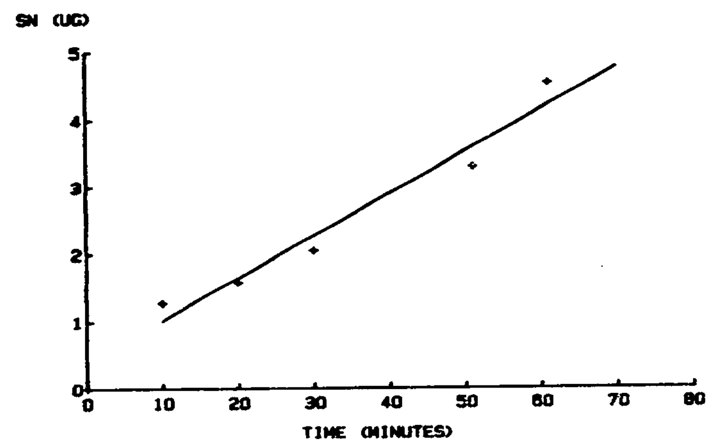
SLOPE= 5.121648E-02   INTERCEPT= 2.183482   R2= .9833439

LEACH RATE= .25 (UG TBTO/CM2/DAY)   POINTS EXCLUDED= 0

Figure B-5.

SHIP: USS CORAL SEA   DATE: 9 JULY 84

PAINT SYSTEM: SPC 254   STATION: B/GREEN



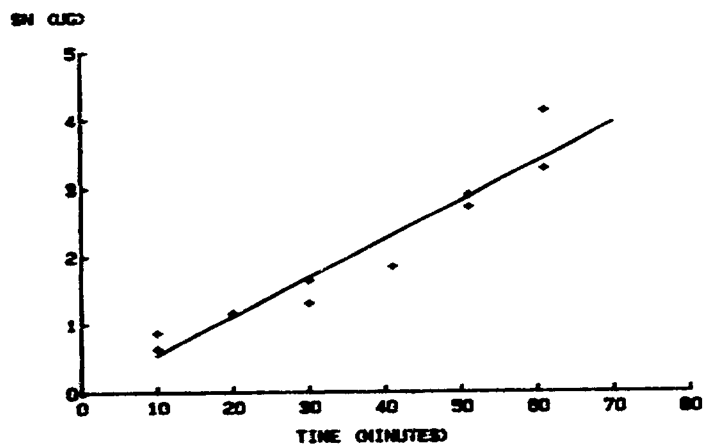
SLOPE= 6.234212E-02   INTERCEPT= .3954314   R2= .9576326

LEACH RATE= .31 (UG TBTO/CM2/DAY)   POINTS EXCLUDED= 0

Figure B-6.

SHIP: USS CORAL SEA   DATE: 9 JULY 84

PAINT SYSTEM: SPC 254   STATION: B/POOLED DATA



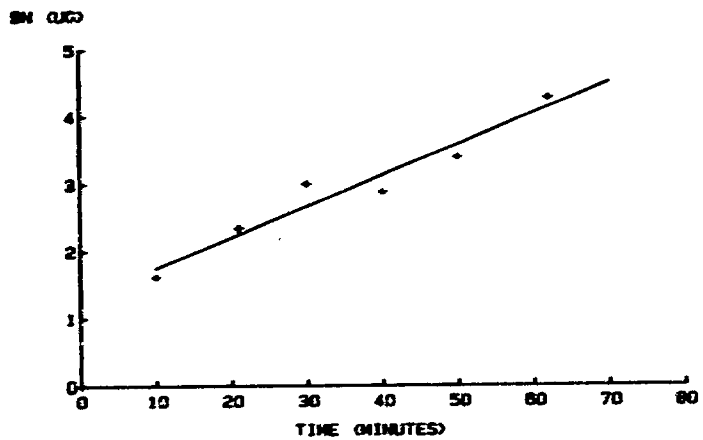
SLOPE= 5.641095E-02   INTERCEPT=-8.019981E-03   R2= .9205802

LEACH RATE= .28 UG TBTO/CM2/DAY 95% CL= 22 %   POINTS EXCLUDED= 0

Figure B-7.

SHIP: USS CORAL SEA   DATE: 10 JULY 84

PAINT SYSTEM: SPC 254   STATION: E/RED

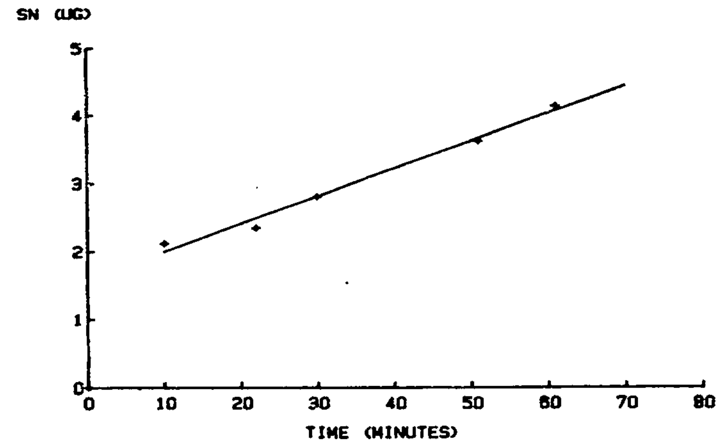


SLOPE= 4.609271E-02   INTERCEPT= 1.280376   R2= .9379266

LEACH RATE= .23 (UG TBTO/CM2/DAY)   POINTS EXCLUDED= 0

Figure B-8.

PAINT SYSTEM: SPC 254   STATION: E/GREEN



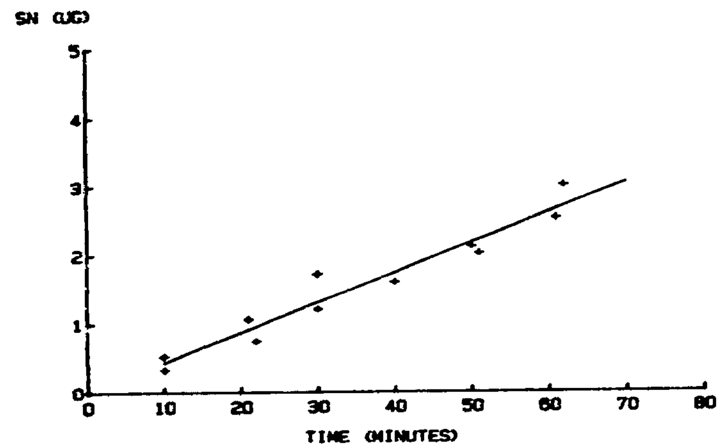
SLOPE= .0402433   INTERCEPT= 1.597533   R2= .9857395

LEACH RATE= .2 (UG TBTO/CM2/DAY)   POINTS EXCLUDED= 0

Figure B-9.

SHIP: USS CORAL SEA   DATE: 10 JULY 84

PAINT SYSTEM: SPC 254   STATION: E/POOLED DATA



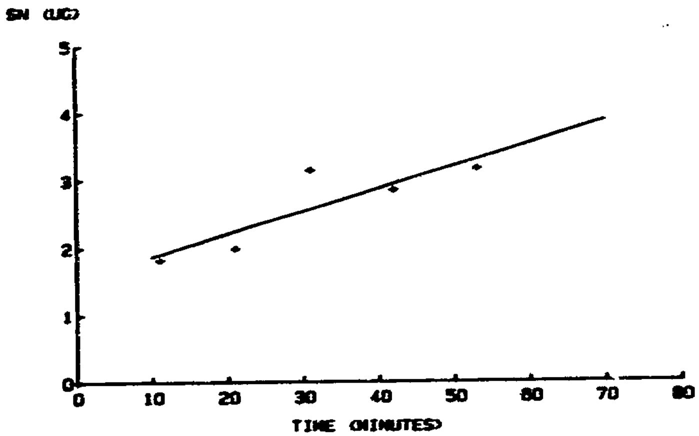
SLOPE= 4.333877E-02   INTERCEPT= 3.445018E-03   R2= .9378179

LEACH RATE= .21 UG TBTO/CM2/DAY   95% CL= 19 %   POINTS EXCLUDED= 0

Figure B-10.

SHIP: USS CORAL SEA DATE: 10 JULY 1984

PAINT SYSTEM: SPC 254 (NO SLIME) STATION: EA/RED



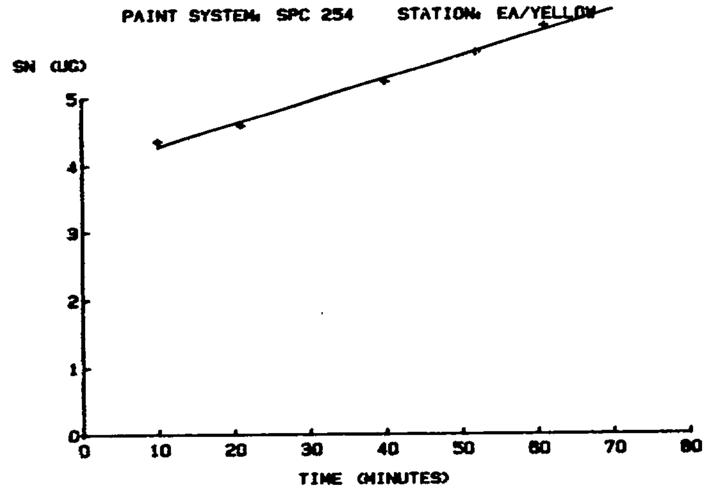
SLOPE= 3.335213E-02 INTERCEPT= 1.538073 R2= .7448887

LEACH RATE= .16 (UG TBTO/CM2/DAY) POINTS EXCLUDED= 0

Figure B-11.

SHIP: USS CORAL SEA DATE: 10 JULY 84

PAINT SYSTEM: SPC 254 STATION: EA/YELLOW



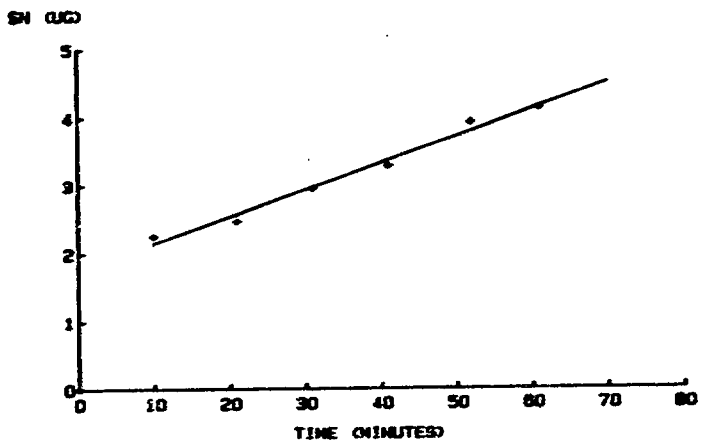
SLOPE= 3.377982E-02 INTERCEPT= 3.934902 R2= .9913483

LEACH RATE= .17 (UG TBTO/CM2/DAY) POINTS EXCLUDED= 0

Figure B-12.

SHIP: USS CORAL SEA DATE: 10 JULY 1984

PAINT SYSTEM: SPC 254 STATION: EA/GREEN



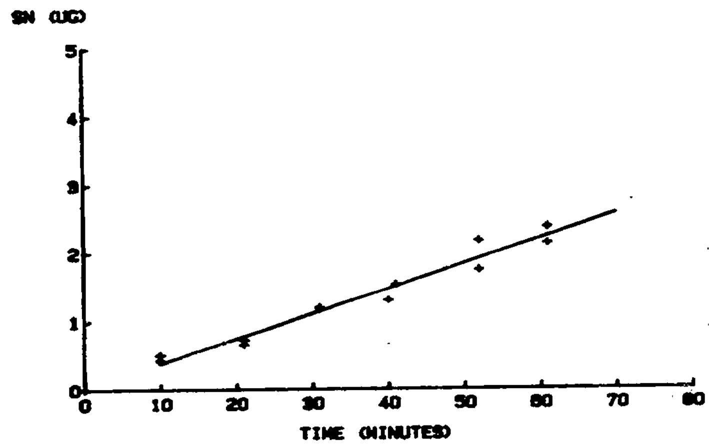
SLOPE= 3.923037E-02 INTERCEPT= 1.75104 R2= .9837253

LEACH RATE= .19 (UG TBTO/CM2/DAY) POINTS EXCLUDED= 0

Figure B-13.

SHIP: USS CORAL SEA DATE: 10 JULY 84

PAINT SYSTEM: SPC 254 STATION: EA/POOLED DATA



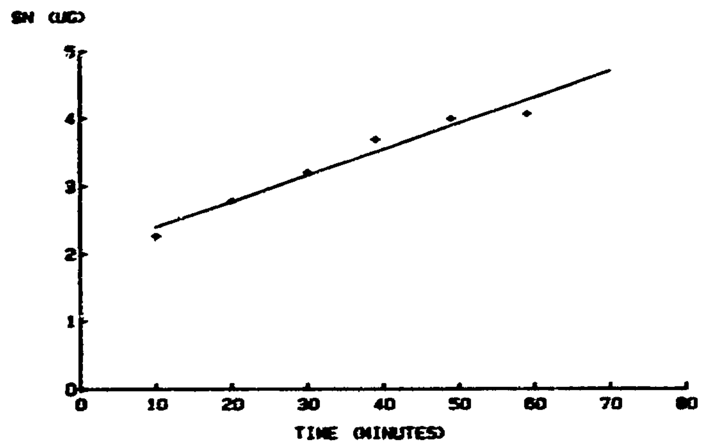
SLOPE= 3.641607E-02 INTERCEPT= 1.308119E-02 R2= .9811226

LEACH RATE= .18 UG TBTO/CM2/DAY 95% CL= 15 % POINTS EXCLUDED= 0

Figure B-14.

SHIP: USS CORAL SEA   DATE: 10 JULY 1984

PAINT SYSTEM: SPC 254 (NO SLIME)   STATION: F/RED



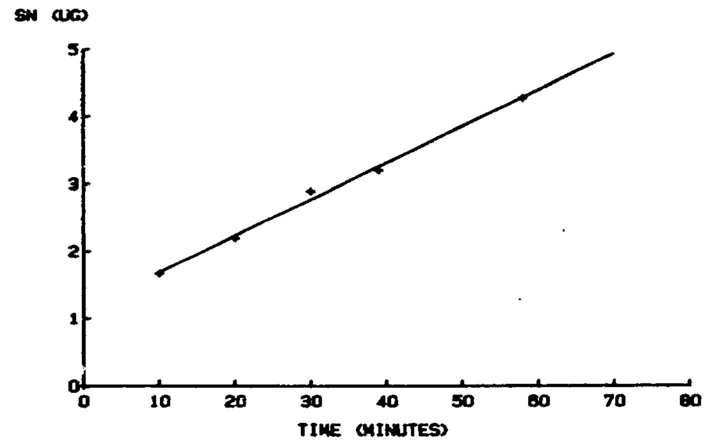
SLOPE= 3.857882E-02   INTERCEPT= 2.004107   R2= .9586036

LEACH RATE= .19 (UG TBTO/CM2/DAY)   POINTS EXCLUDED= 0

Figure B-15.

SHIP: USS CORAL SEA   DATE: 10 JULY 1984

PAINT SYSTEM: SPC 254 (NO SLIME)   STATION: F/GREEN



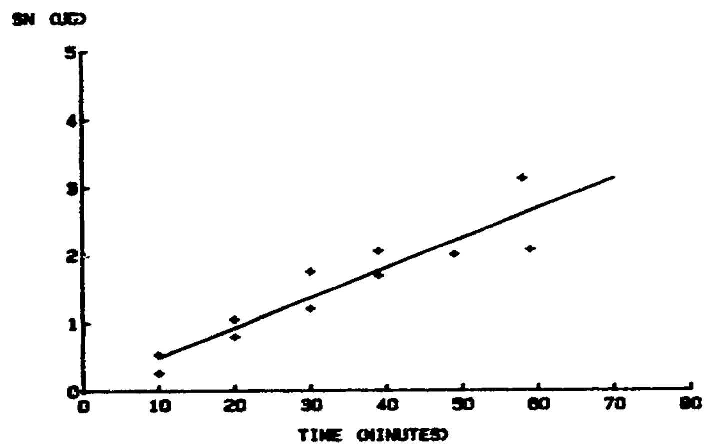
SLOPE= 5.408057E-02   INTERCEPT= 1.14187   R2= .9946719

LEACH RATE= .27 (UG TBTO/CM2/DAY)   POINTS EXCLUDED= 0

Figure B-16.

SHIP: USS CORAL SEA   DATE: 10 JULY 84

PAINT SYSTEM: SPC 254 (NO SLIME)   STATION: F/POOLED DATA



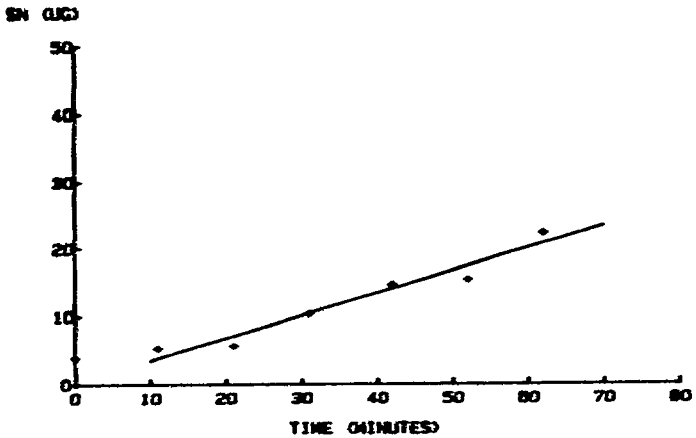
SLOPE= .0441351   INTERCEPT= 4.049857E-02   R2= .8556212

LEACH RATE= .22 UG TBTO/CM2/DAY 95% CL= 31 %   POINTS EXCLUDED= 0

Figure B-17.

SHIP: USS BIRMINGHAM   DATE: 11 JULY 1984

PAINT SYSTEM: ABC-2   STATION: H/RED



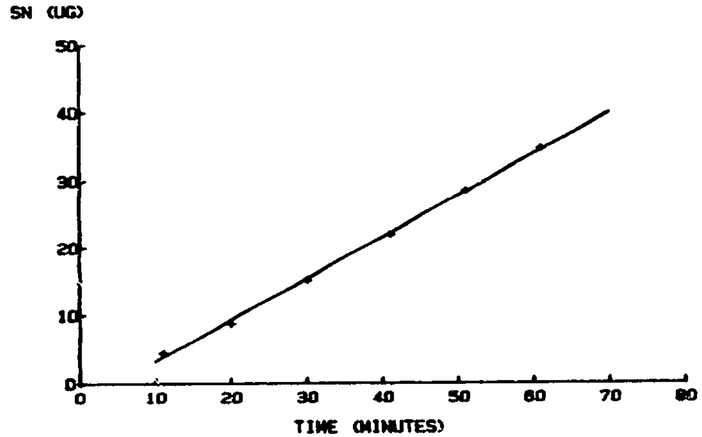
SLOPE= .3324139   INTERCEPT= .1368942   R2= .9478772

LEACH RATE= 1.64 (UG TBTO/CM2/DAY)   POINTS EXCLUDED= 1

Figure B-18.

SHIP: USS BIRMINGHAM   DATE: 11 JULY 1984

PAINT SYSTEM: ABC-2   STATION: H/YELLOW



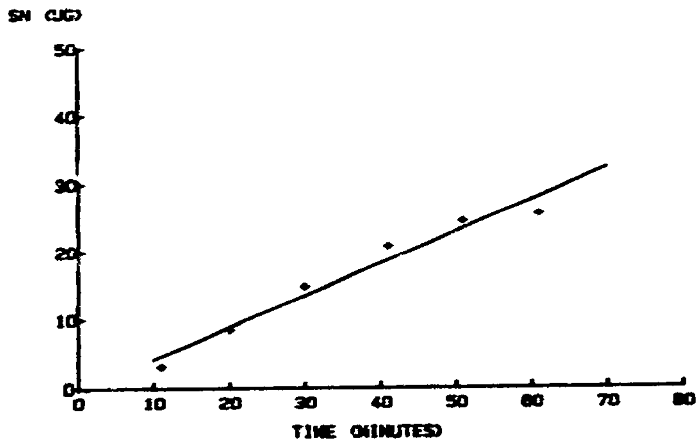
SLOPE= .6119238   INTERCEPT=-2.945496   R2= .9988632

LEACH RATE= 3.02 (UG TBTO/CM2/DAY)   POINTS EXCLUDED=

Figure B-19.

SHIP: USS BIRMINGHAM   DATE: 11 JULY 1984

PAINT SYSTEM: ABC-2   STATION: H/GREEN



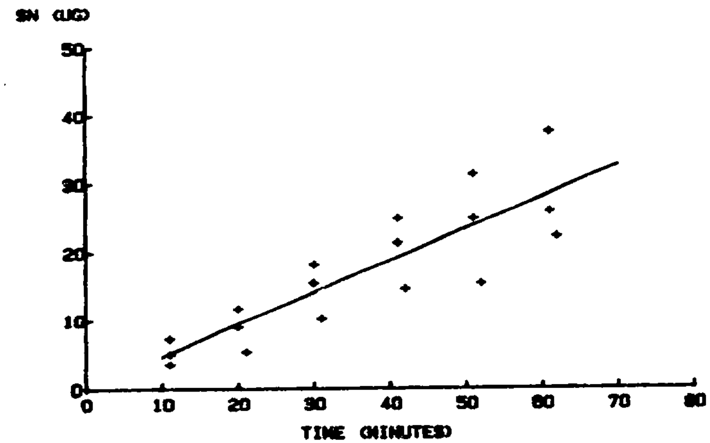
SLOPE= .4674211   INTERCEPT=-.4880188   R2= .9593909

LEACH RATE= 2.31 (UG TBTO/CM2/DAY)   POINTS EXCLUDED= 0

Figure B-20.

SHIP: USS BIRMINGHAM   DATE: 11 JULY 84

PAINT SYSTEM: ABC-2   STATION: H/POOLED DATA



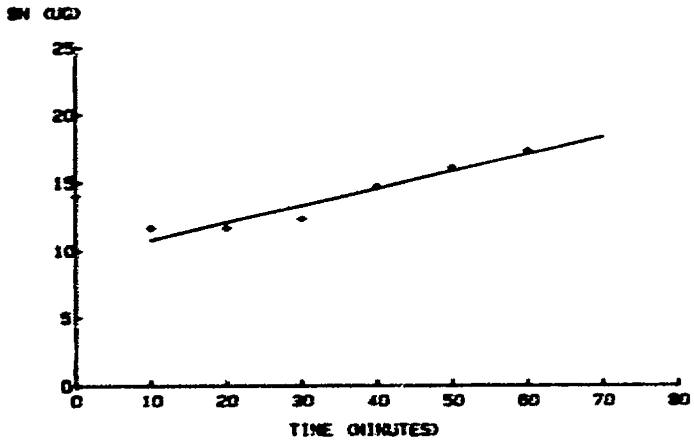
SLOPE= .4648957   INTERCEPT= .1745504   R2= .7431948

LEACH RATE= 2.29 UG TBTO/CM2/DAY   95% CL= 91 %   POINTS EXCLUDED= 0

Figure B-21.

SHIP: USS MEYERKORD DATE: 14 AUG 84

PAINT SYSTEM: ABC-2 STATION: C/RED



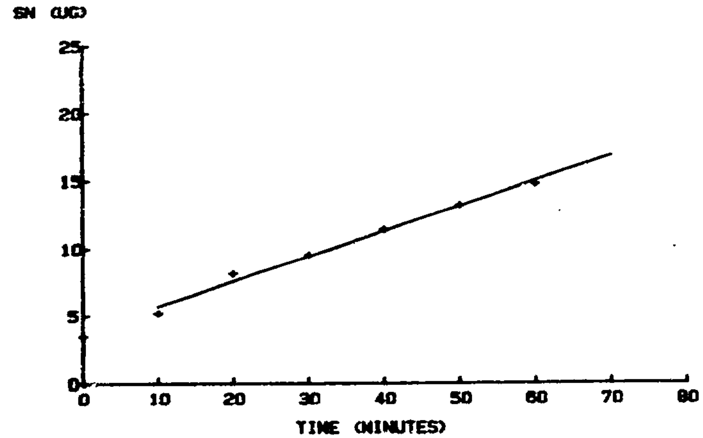
SLOPE= .128343 INTERCEPT= 9.531328 R2= .9321801

LEACH RATE= .82 (UG TBTO/CM2/DAY) POINTS EXCLUDED= 1

Figure B-22.

SHIP: USS MEYERKORD DATE: 14 AUG 1984

PAINT SYSTEM: ABC-2 STATION: C/YELLOW



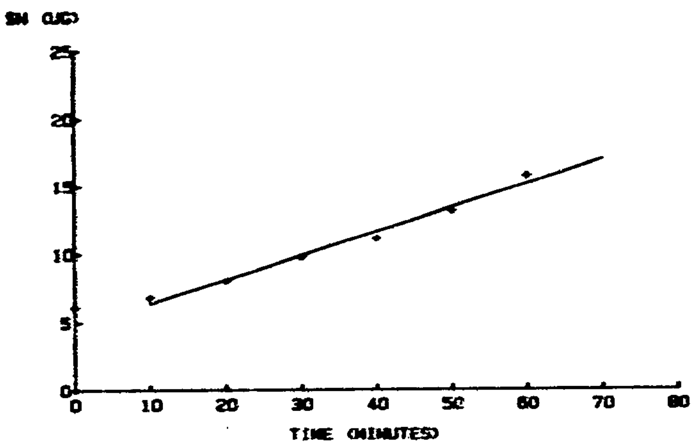
SLOPE= .1851144 INTERCEPT= 3.875998 R2= .988736

LEACH RATE= .91 (UG TBTO/CM2/DAY) POINTS EXCLUDED= 1

Figure B-23.

SHIP: USS MEYERKORD DATE: 14 AUGUST 1984

PAINT SYSTEM: ABC-2 STATION: C/GREEN



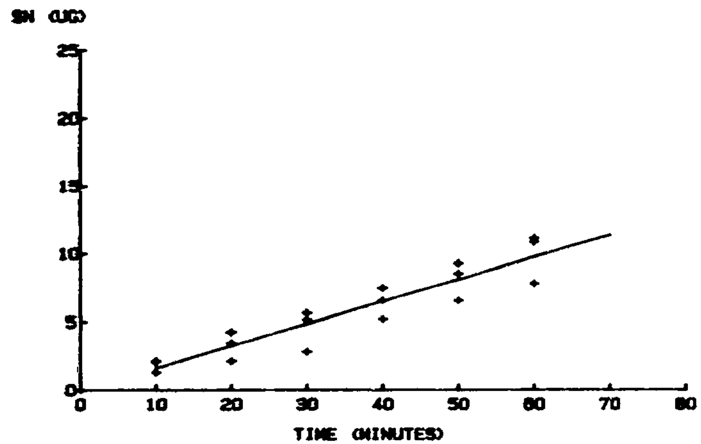
SLOPE= .1781144 INTERCEPT= 4.595998 R2= .9842116

LEACH RATE= .87 (UG TBTO/CM2/DAY) POINTS EXCLUDED= 1

Figure B-24.

SHIP: USS MEYERKORD DATE: 14 AUG 84

PAINT SYSTEM: ABC-2 STATION: C/POOLED DATA

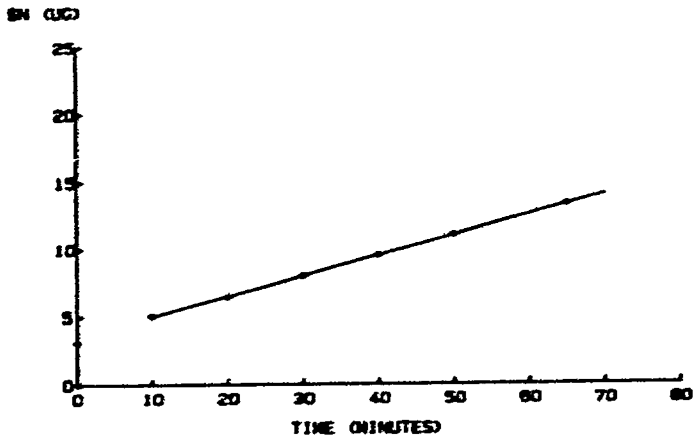


SLOPE= .1690001 INTERCEPT=-.0244487 R2= .9356807

LEACH RATE= .8 UG TBTO/CM2/DAY 95% CL= 21 % POINTS EXCLUDED= 0

Figure B-25.

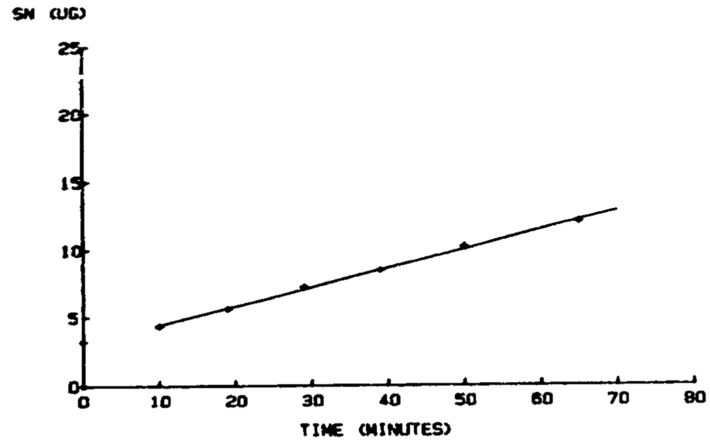
SHIP: USS MEYERKORD DATE: 15 AUG 1984
PAINT SYSTEM: ABC-2 STATION: C/RED



SLOPE= .1500038 INTERCEPT= 3.482722 R2= .9998249
LEACH RATE= .74 (UG TBTO/CM2/DAY) POINTS EXCLUDED= 1

Figure B-26.

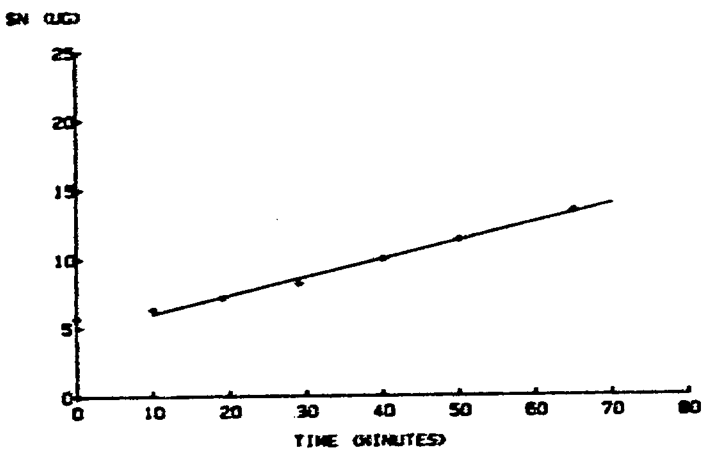
SHIP: USS MEYERKORD DATE: 15 AUG 1984
PAINT SYSTEM: ABC-2 STATION: C/YELLOW



SLOPE= .1398639 INTERCEPT= 3.029811 R2= .9976775
LEACH RATE= .69 (UG TBTO/CM2/DAY) POINTS EXCLUDED= 1

Figure B-27.

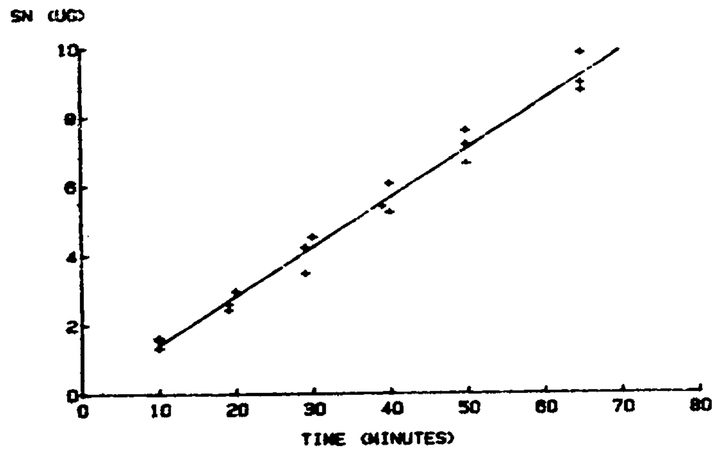
SHIP: USS MEYERKORD DATE: 15 AUG 1984
PAINT SYSTEM: ABC-2 STATION: C/GREEN



SLOPE= .1319827 INTERCEPT= 4.704815 R2= .9932235
LEACH RATE= .65 (UG TBTO/CM2/DAY) POINTS EXCLUDED= 1

Figure B-28.

SHIP: USS MEYERKORD DATE: 15 AUG 84
PAINT SYSTEM: ABC-2 STATION: C/POOLED DATA

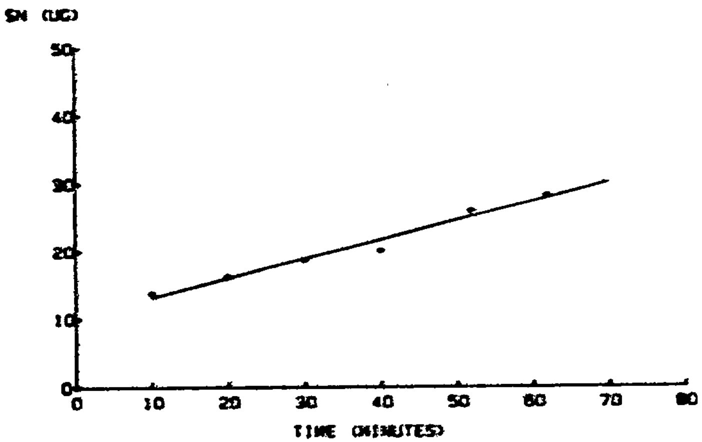


SLOPE= .1409995 INTERCEPT=-1.647102E-03 R2= .9827342
LEACH RATE= .7 UG TBTO/CM2/DAY 95% CL= 7 % POINTS EXCLUDED= 0

Figure B-29.

SHIP: USS MEYERKORD DATE: 14 AUG 1984

PAINT SYSTEM: OMP 585 STATION: F/RED



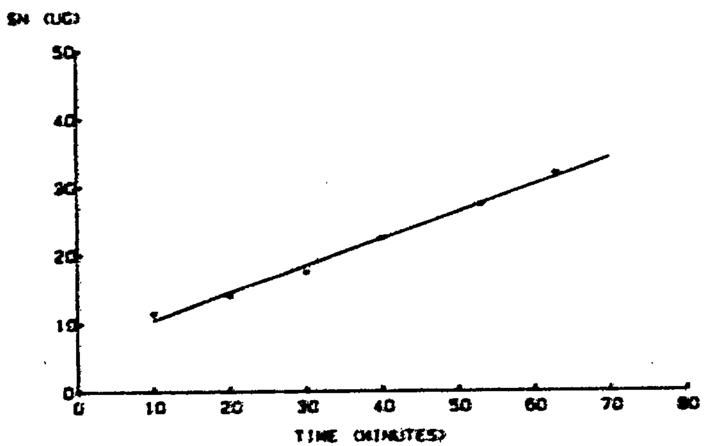
SLOPE= .2806884 INTERCEPT= 10.44816 R2= .9754071

LEACH RATE= 1.38 (UG TBTO/CM2/DAY) POINTS EXCLUDED= 1

Figure B-30.

SHIP: USS MEYERKORD DATE: 14 AUG 1984

PAINT SYSTEM: OMP 585 STATION: F/GREEN



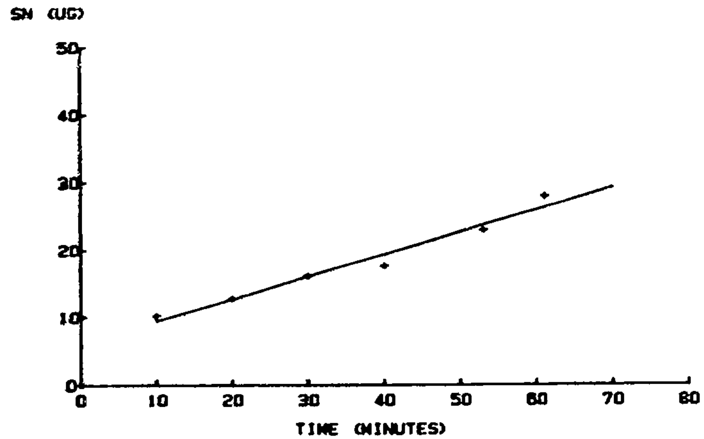
SLOPE= .3932217 INTERCEPT= 6.59902 R2= .9930123

LEACH RATE= 1.94 (UG TBTO/CM2/DAY) POINTS EXCLUDED= 0

Figure B-32.

SHIP: USS MEYERKORD DATE: 14 AUG 1984

PAINT SYSTEM: OMP 585 STATION: F/YELLOW



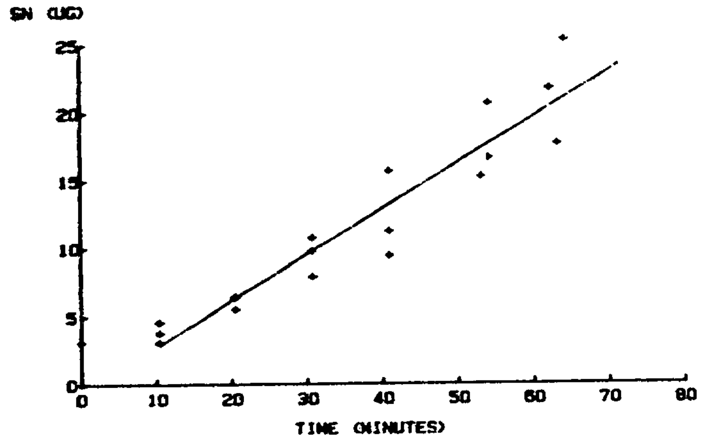
SLOPE= .3299225 INTERCEPT= 6.149431 R2= .9670065

LEACH RATE= 1.63 (UG TBTO/CM2/DAY) POINTS EXCLUDED= 1

Figure B-31.

SHIP: USS MEYERKORD DATE: 14 AUG 84

PAINT SYSTEM: OMP 585 STATION: F/POOLED DATA



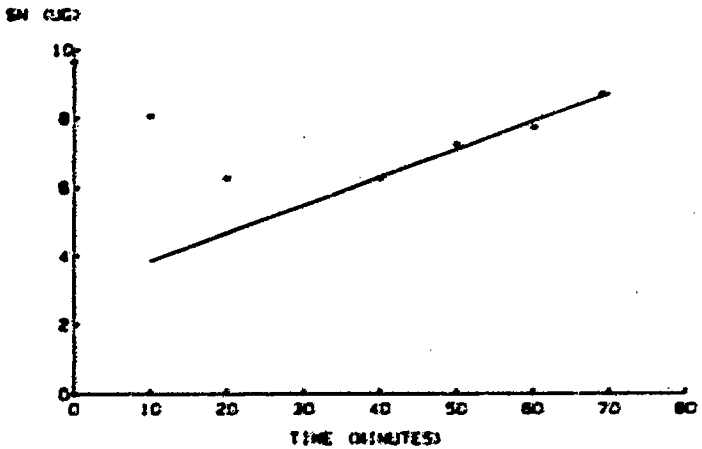
SLOPE= .3383598 INTERCEPT=-.1735399 R2= .8998822

LEACH RATE= 1.67 UG TBTO/CM2/DAY 95% CL= 18 % POINTS EXCLUDED= 0

Figure B-33.

SHIP: USS MEYERKORD   DATE: 14 AUG 1984

PAINT SYSTEM: SPC-4   STATION: B/RED



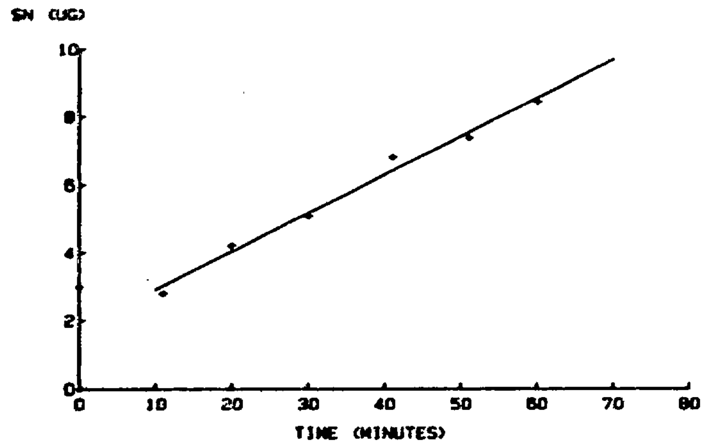
SLOPE= 8.129811E-02   INTERCEPT= 3.039036   R2= .9812678

LEACH RATE= .4 (UG TBTO/CM2/DAY)   POINTS EXCLUDED= 3

Figure B-34.

SHIP: USS MEYERKORD   DATE: 14 AUG 1984

PAINT SYSTEM: SPC-4   STATION: B/YELLOW



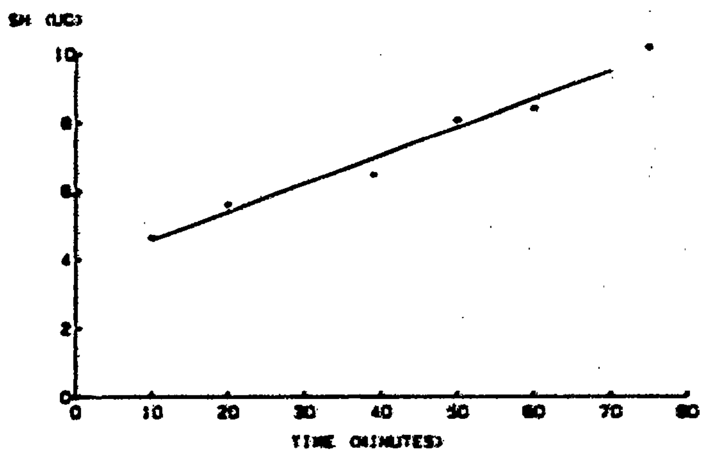
SLOPE= .1130233   INTERCEPT= 1.777874   R2= .9873233

LEACH RATE= .58 (UG TBTO/CM2/DAY)   POINTS EXCLUDED= 1

Figure B-35.

SHIP: USS MEYERKORD   DATE: 14 AUG 1984

PAINT SYSTEM: SPC-4   STATION: B/GREEN



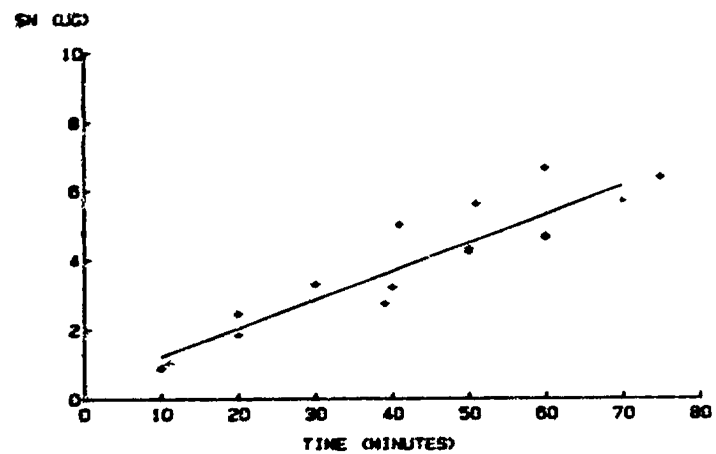
SLOPE= 8.172847E-02   INTERCEPT= 3.752452   R2= .9775804

LEACH RATE= .4 (UG TBTO/CM2/DAY)   POINTS EXCLUDED= 1

Figure B-36.

SHIP: USS MEYERKORD   DATE: 14 AUG 84

PAINT SYSTEM: SPC-4   STATION: B/POOLED DATA



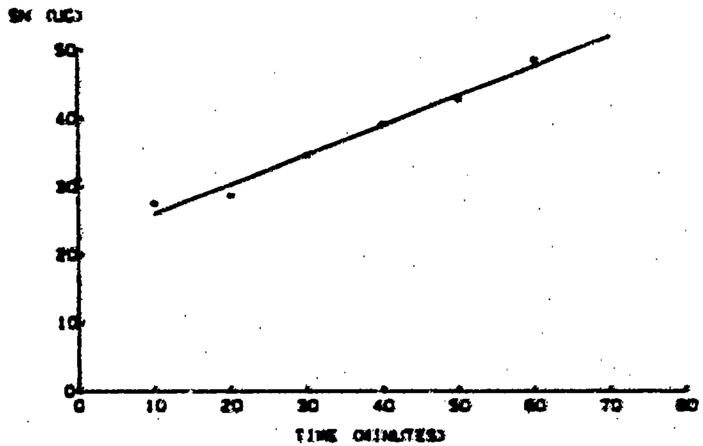
SLOPE= 8.198831E-02   INTERCEPT= .395464   R2= .8507319

LEACH RATE= .4 UG TBTO/CM2/DAY 95% CL= 24 % POINTS EXCLUDED= 0

Figure B-37.

SHIP, USS MEYERKORD DATE, 14 AUG 84

PAINT SYSTEM, DNP M5211F STATION, A/RED



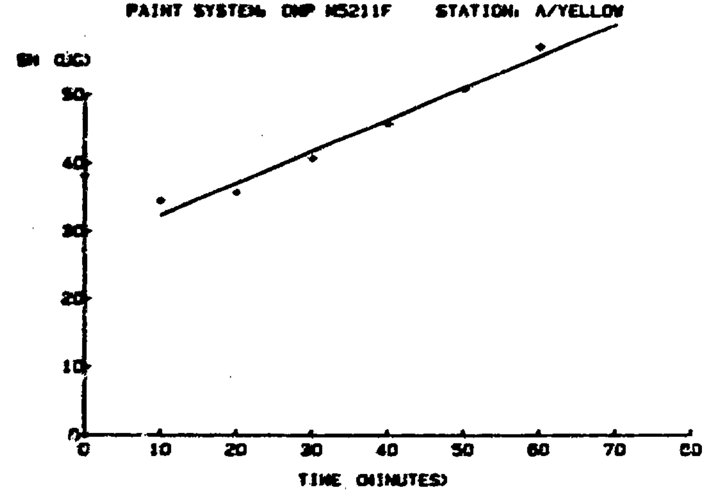
SLOPE= .4381429 INTERCEPT= 21.81887 R2= .9813521

LEACH RATE= 2.15 (UG TBTO/CM2/DAY) POINTS EXCLUDED= 1

Figure B-38.

SHIP, USS MEYERKORD DATE, 14 AUG 84

PAINT SYSTEM, DNP M5211F STATION, A/YELLOW



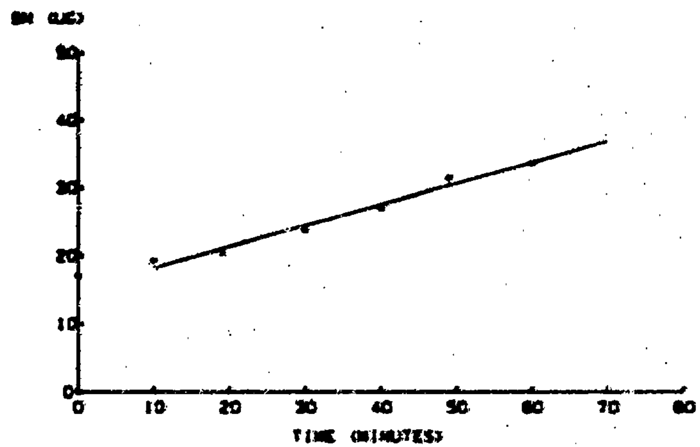
SLOPE= .4661142 INTERCEPT= 27.73267 R2= .9780683

LEACH RATE= 2.3 (UG TBTO/CM2/DAY) POINTS EXCLUDED= 1

Figure B-39.

SHIP, USS MEYERKORD DATE, 14 AUG 84

PAINT SYSTEM, DNP M5211F STATION, A/GREEN



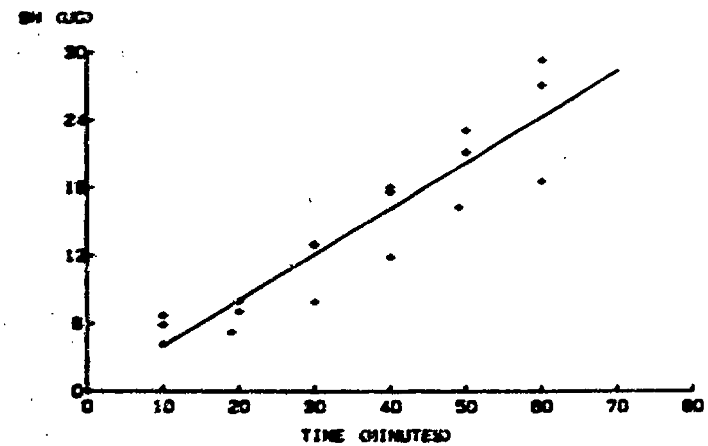
SLOPE= .3080144 INTERCEPT= 15.17787 R2= .9788308

LEACH RATE= 1.53 (UG TBTO/CM2/DAY) POINTS EXCLUDED= 1

Figure B-40.

SHIP, USS MEYERKORD DATE, 14 AUG 84

PAINT SYSTEM, DNP M5211F STATION, A/POOLED DATA



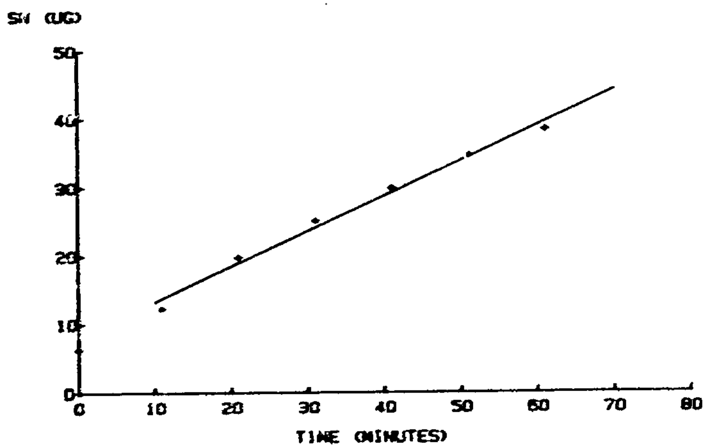
SLOPE= .4030872 INTERCEPT=-8.850814E-02 R2= .8530178

LEACH RATE= 2 UG TBTO/CM2/DAY 95% CL= 22 % POINTS EXCLUDED= 0

Figure B-41.

SHIP: USS MEYERKORD   DATE: 15 AUG 1984

PAINT SYSTEM: OMP 5211S   STATION: G/RED



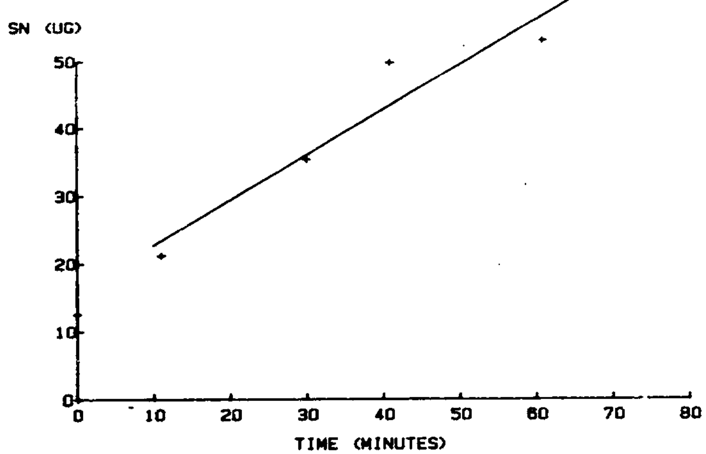
SLOPE= .5152002   INTERCEPT= 8.12313   R2= .9879191

LEACH RATE= 2.54 (UG TBTO/CM2/DAY)   POINTS EXCLUDED= 1

Figure B-42.

SHIP: USS MEYERKORD   DATE: 15 AUG 1984

PAINT SYSTEM: OMP 5211S   STATION: G/YELLOW



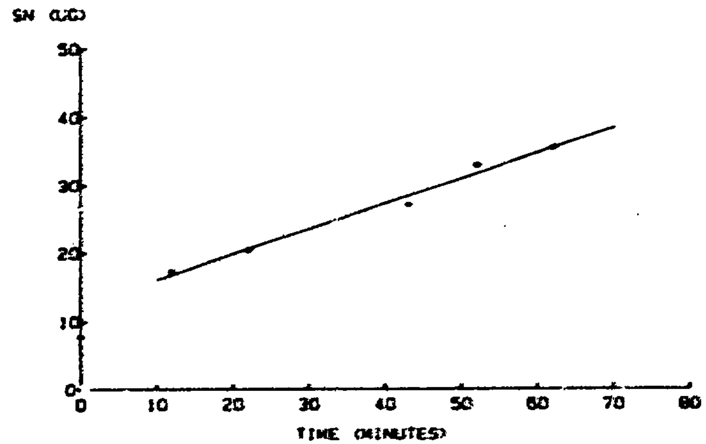
SLOPE= .6854148   INTERCEPT= 16.05292   R2= .9072236

LEACH RATE= 3.28 (UG TBTO/CM2/DAY)   POINTS EXCLUDED= 1

Figure B-43.

SHIP: USS MEYERKORD   DATE: 15 AUG 1984

PAINT SYSTEM: OMP 5211S   STATION: G/GREEN



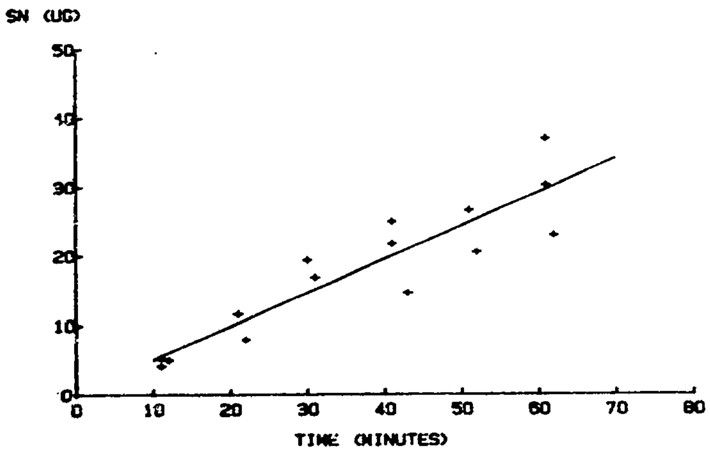
SLOPE= .3713712   INTERCEPT= 12.43782   R2= .9856026

LEACH RATE= 1.83 (UG TBTO/CM2/DAY)   POINTS EXCLUDED= 1

Figure B-44.

SHIP: USS MEYERKORD   DATE: 15 AUG 84

PAINT SYSTEM: OMP 5211S   STATION: G/POOLED DATA



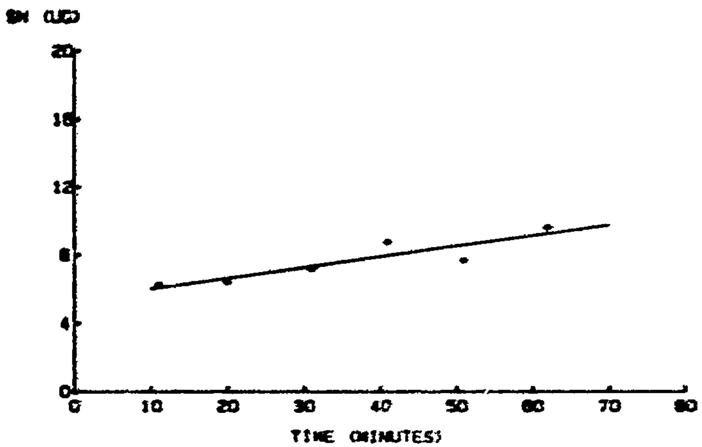
SLOPE= .4830847   INTERCEPT= .1715617   R2= .8255799

LEACH RATE= 2.30 UG TBTO/CM2/DAY   95% CL= 28 %   POINTS EXCLUDED= 0

Figure B-45.

SHIP: USS MEYERKORD   DATE: 11 DECEMBER 1984

PAINT SYSTEM: ABC-2   STATION: A/RED



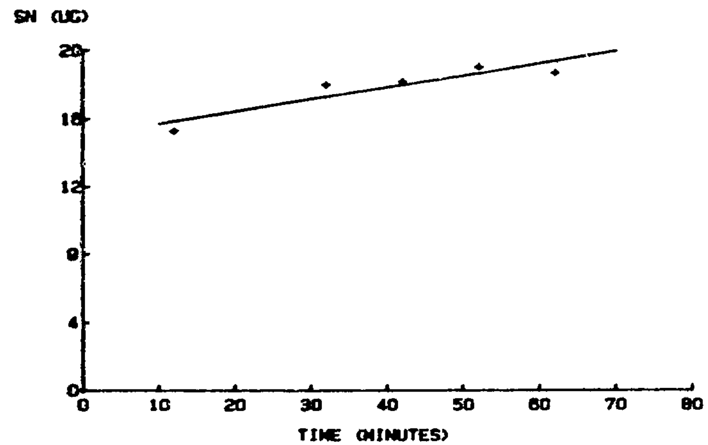
SLOPE= 6.288818E-02   INTERCEPT= 5.385578   R2= .806320

LEACH RATE= .31 UG TBTO/CM2/DAY   95% CL= 68 %   POINTS EXCLUDED= 0

Figure B-46.

SHIP: USS MEYERKORD   DATE: 11 DECEMBER 1984

PAINT SYSTEM: ABC-2   STATION: A/YELLOW



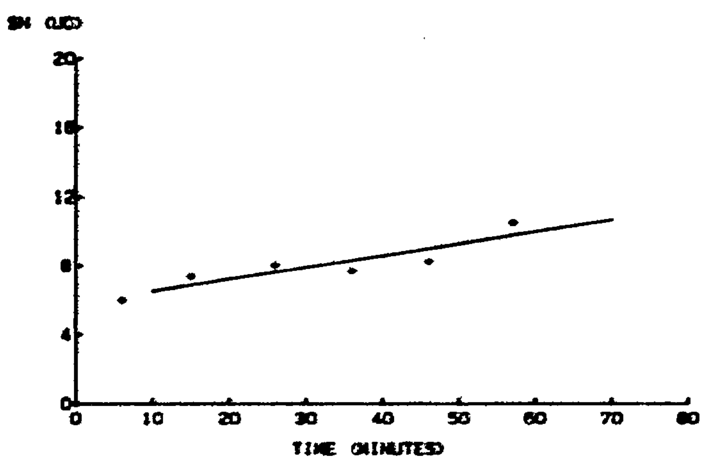
SLOPE= 7.039168E-02   INTERCEPT= 15.03233   R2= .8320648

LEACH RATE= .35 UG TBTO/CM2/DAY   95% CL= 83 %   POINTS EXCLUDED= 0

Figure B-47.

SHIP: USS MEYERKORD   DATE: 11 DECEMBER 1984

PAINT SYSTEM: ABC-2   STATION: A/GREEN



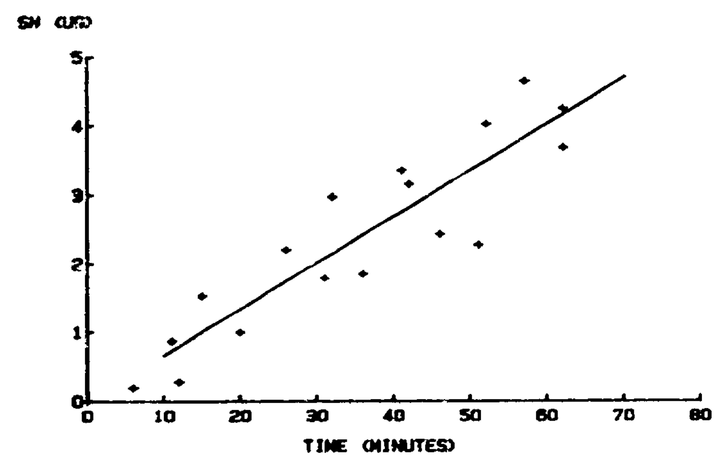
SLOPE= 6.887005E-02   INTERCEPT= 5.833362   R2= .8181508

LEACH RATE= .34 UG TBTO/CM2/DAY   95% CL= 86 %   POINTS EXCLUDED= 0

Figure B-48.

SHIP: USS MEYERKORD   DATE: 11 DECEMBER 1984

PAINT SYSTEM: ABC-2   STATION: A/POOLED DATA



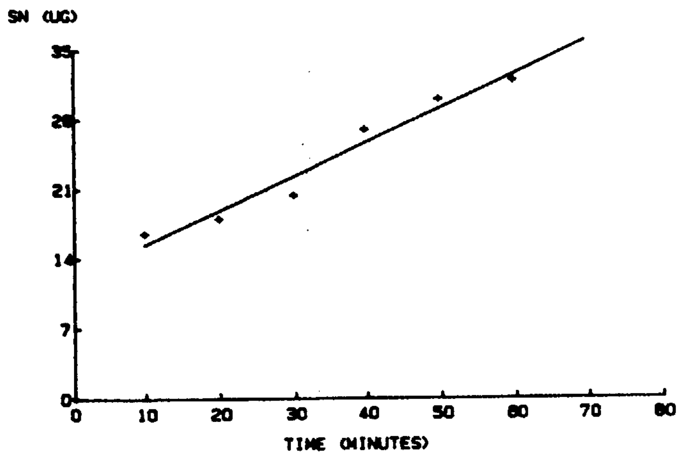
SLOPE= 6.725348E-02   INTERCEPT=-4.093619E-03   R2= .8158756

LEACH RATE= .33 UG TBTO/CM2/DAY   95% CL= 28 %   POINTS EXCLUDED= 0

Figure B-49.

SHIP: USS MEYERKORD   DATE: 11 DECEMBER 1984

PAINT SYSTEM: OMP 5211F   STATION: B/RED



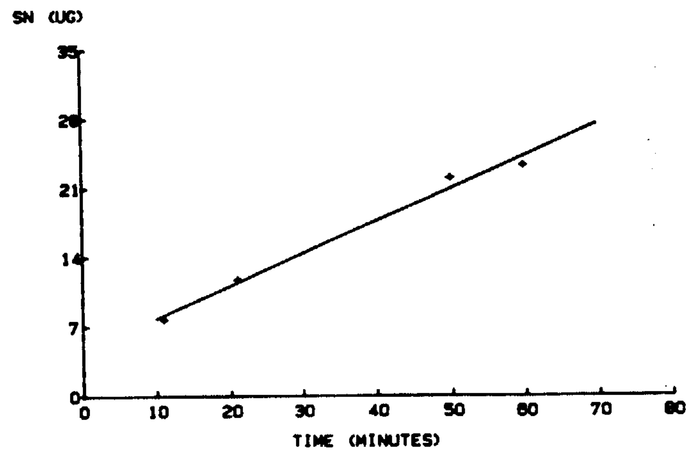
SLOPE= .3389427   INTERCEPT= 12.032   R2= .9807438

LEACH RATE= 1.67 UG TBTO/CM2/DAY 95% CL= 28 %   POINTS EXCLUDED= 0

Figure B-50.

SHIP: USS MEYERKORD   DATE: 11 DECEMBER 1984

PAINT SYSTEM: OMP5211F   STATION: B/YELLOW



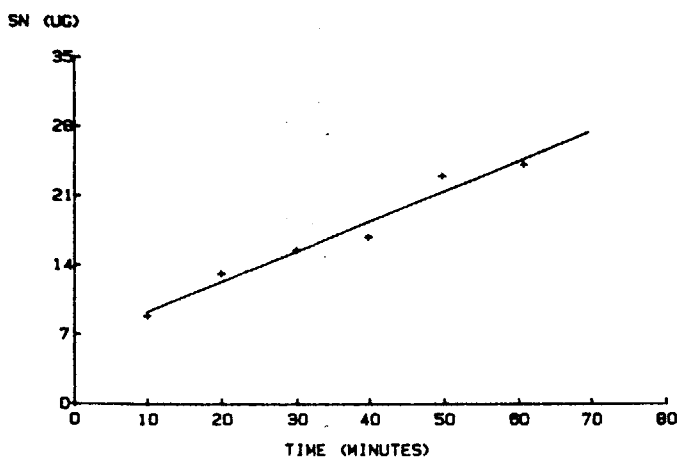
SLOPE= .326857   INTERCEPT= 4.539075   R2= .9869413

LEACH RATE= 1.61 UG TBTO/CM2/DAY 95% CL= 35 %   POINTS EXCLUDED= 0

Figure B-51.

SHIP: USS MEYERKORD   DATE: 11 DECEMBER 1984

PAINT SYSTEM: OMP 5211F   STATION: B/GREEN



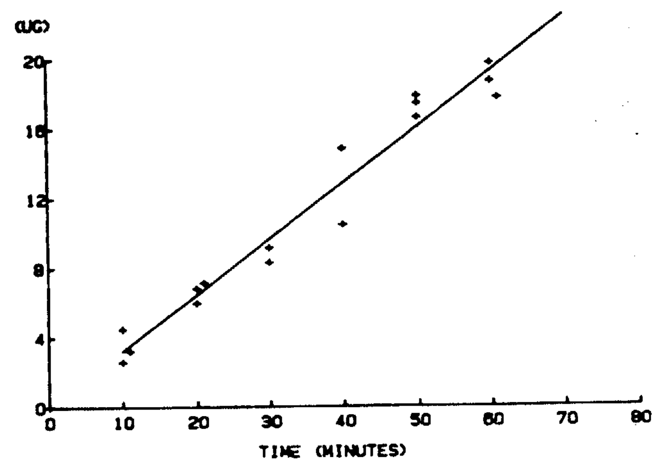
SLOPE= .300182   INTERCEPT= 8.272639   R2= .9835076

LEACH RATE= 1.48 UG TBTO/CM2/DAY 95% CL= 27 %   POINTS EXCLUDED= 0

Figure B-52.

SHIP: USS MEYERKORD   DATE: 11 DECEMBER 1984

PAINT SYSTEM: OMP 5211F   STATION: B/POOLED DATA



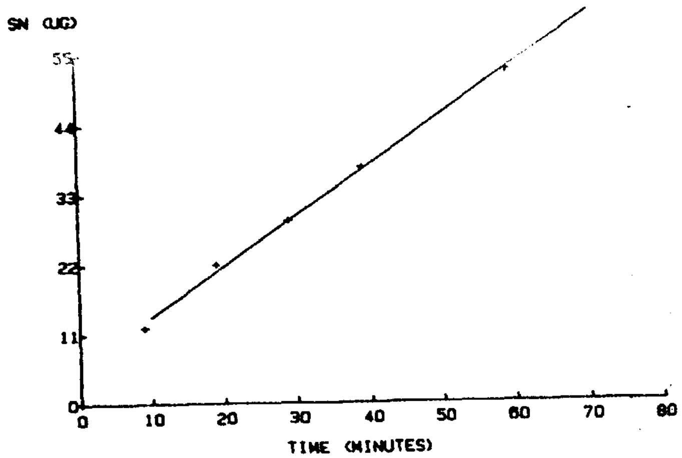
SLOPE= .3214439   INTERCEPT= 2.943993E-03   R2= .9573793

LEACH RATE= 1.59 UG TBTO/CM2/DAY 95% CL= 12 %   POINTS EXCLUDED= 0

Figure B-53.

SHIP: USS MEYERKORD DATE: 11 DECEMBER 1984

PAINT SYSTEM: OMP 5211S STATION: C/RED



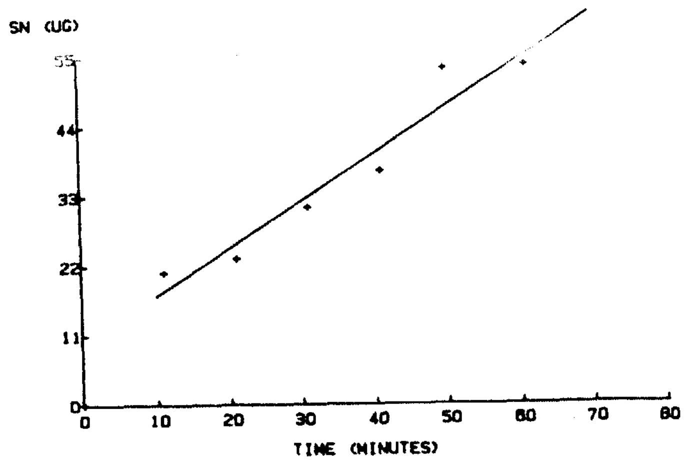
SLOPE= .7899322 INTERCEPT= 5.842104 R2= .997175

LEACH RATE= 3.9 UG TBTO/CM2/DAY 95% CL= 10 % POINTS EXCLUDED= 0

Figure B-54.

SHIP: USS MEYERKORD DATE: 11 DECEMBER 1984

PAINT SYSTEM: OMP 5211S STATION: C/YELLOW



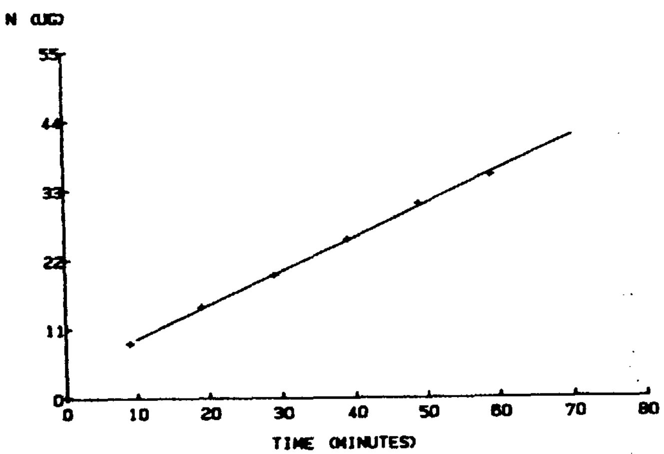
SLOPE= .7448181 INTERCEPT= 9.859021 R2= .933685

LEACH RATE= 3.67 UG TBTO/CM2/DAY 95% CL= 37 % POINTS EXCLUDED= 0

Figure B-55.

SHIP: USS MEYERKORD DATE: 11 DECEMBER 1984

PAINT SYSTEM: OMP 5211S STATION: C/GREEN



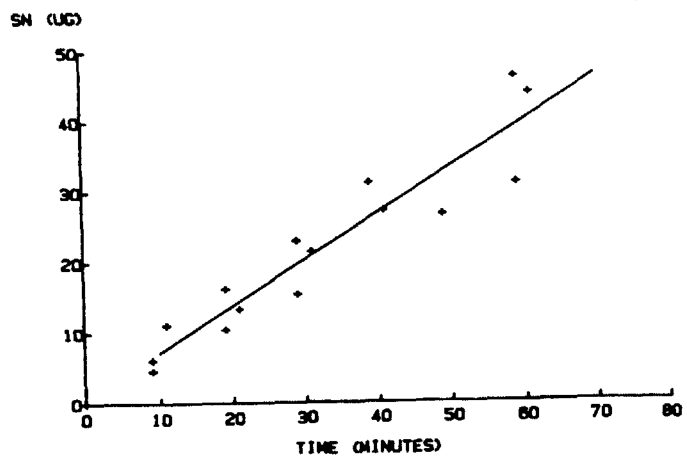
SLOPE= .5332282 INTERCEPT= 4.141908 R2= .9989588

LEACH RATE= 2.63 UG TBTO/CM2/DAY 95% CL= 4 % POINTS EXCLUDED= 0

Figure B-56.

SHIP: USS MEYERKORD DATE: 11 DECEMBER 1984

PAINT SYSTEM: OMP 5211S STATION: C/POOLED DATA



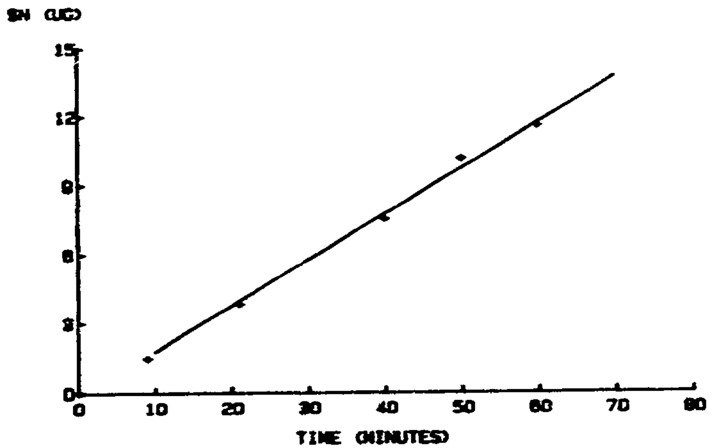
SLOPE= .651442 INTERCEPT= .744041 R2= .8881128

LEACH RATE= 3.21 UG TBTO/CM2/DAY 95% CL= 21 % POINTS EXCLUDED= 0

Figure B-57.

SHIP: USS MEYERKORD DATE: 12 DECEMBER 1984

PAINT SYSTEM: SPC-4 STATION: E/RED



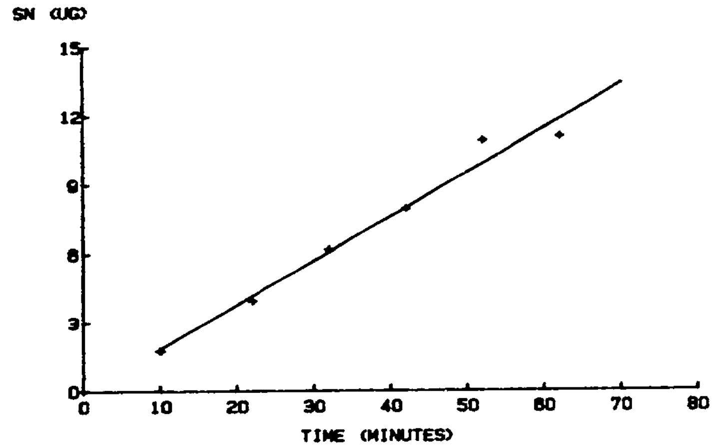
SLOPE= .1983133 INTERCEPT=-.1843987 R2= .9971086

LEACH RATE= .98 UG TBTO/CM2/DAY 95% CL= 7 % POINTS EXCLUDED= 0

Figure B-58.

SHIP: USS MEYERKORD DATE: 12 DECEMBER 1984

PAINT SYSTEM: SPC-4 STATION: E/YELLOW



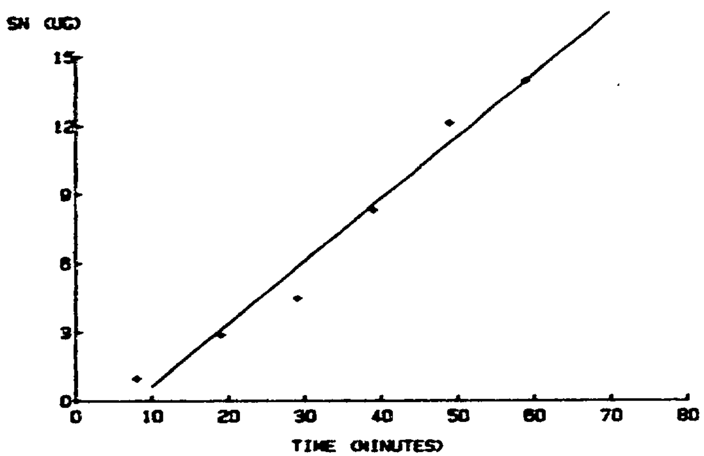
SLOPE= .1921294 INTERCEPT=-7.474327E-02 R2= .9768207

LEACH RATE= .95 UG TBTO/CM2/DAY 95% CL= 21 % POINTS EXCLUDED= 0

Figure B-59.

SHIP: USS MEYERKORD DATE: 12 DECEMBER 1984

PAINT SYSTEM: SPC-4 STATION: E/GREEN



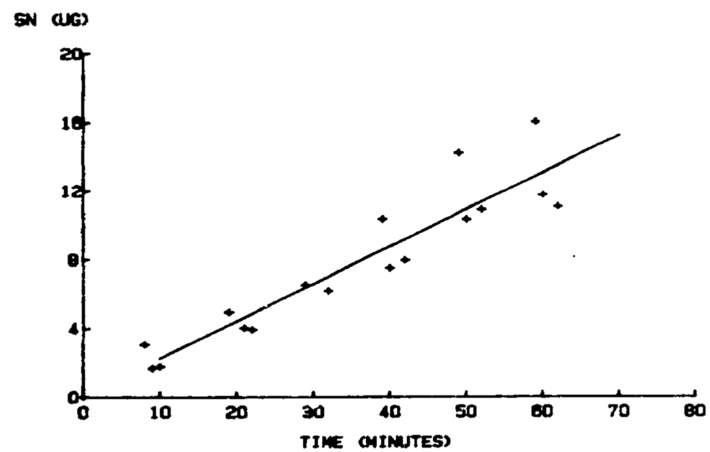
SLOPE= .271502 INTERCEPT=-2.065817 R2= .9743251

LEACH RATE= 1.34 UG TBTO/CM2/DAY 95% CL= 23 % POINTS EXCLUDED= 0

Figure B-60.

SHIP: USS MEYERKORD DATE: 12 DECEMBER 1984

PAINT SYSTEM: SPC-4 STATION: E/POOLED DATA



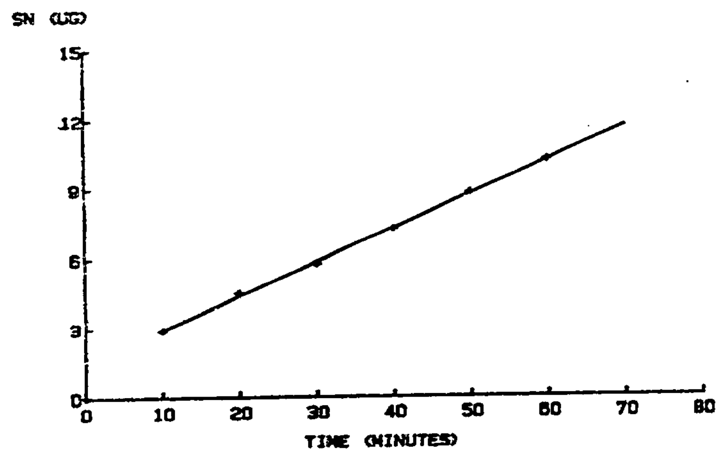
SLOPE= .2166846 INTERCEPT= 9.771998E-02 R2= .8602396

LEACH RATE= 1.07 UG TBTO/CM2/DAY 95% CL= 22 % POINTS EXCLUDED= 0

Figure B-61.

SHIP: USS MEYERKORD   DATE: 12 DECEMBER 1984

PAINT SYSTEM: OMP 585   STATION: D/RED



SLOPE= .1456857   INTERCEPT= 1.482666   R2= .9993251

LEACH RATE= .72 UG TBTO/CM2/DAY   95% CL= 4 %   POINTS EXCLUDED= 0

Figure B-62.

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SSCSD 5720/2 (REV 6-08)

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Public Affairs: Technical Report 1027, July 1985; full title: " In Situ Determination of Butyltin release Rates from Antifouling Coatings on Navy Text Ships." Authors, S.H. Lieberman (NOSC), V. Homer (computer Sciences Corporation), and P.F. Seligman (NOSC). Previously released with Distribution B, U.S. government Agencies Only.

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