

GLENDALE ENERGY

SILOXANE REMOVAL AT
A SMALL LANDFILL GAS TO
ELECTRICAL ENERGY FACILITY
IN THE ARIZONA DESERT

THE FACILITY

- CITY OF GLENDALE LANDFILL
- 2 – GE JENBACHER 420 ENGINES
- RATED AT 2.8 MW TOTAL
- GAS QUALITY AT 40-42 % METHANE
- DESERT CLIMATE ; HIGH DUST
- SWAMP COOLERS FOR HIGH TEMPS



LANDFILL GAS ANALYSIS

- GAS SAMPLE ANALYZED BEFORE ENGINE ORDER PLACED
- SAMPLE SHOWED 9 PPMV (12 MG/M³)
- SIMILAR TO ANOTHER FACILITY NOT AN ISSUE
- GE JENBACHER ALSO SAW NO CONCERN









SILOXANE PROBLEMS

- PROJECT COMMERCIAL : JAN 2010
- IMMEDIATE ENGINE PROBLEMS
- GE BLAMED GAS QUALITY THROUGHOUT
- TACKLED PROBLEMS FOR 2 YEARS
- OBVIOUS SILOXANE BUILD UP
- GLENDALE ENERGY ENGAGED CCA FOR TURNKEY SOLUTION

DESIGN CRITERIA

- REGENERATIVE TOO COSTLY
- LITTLE DATA ON SILICA GEL
- USED VESSEL THAT SHOULD WORK WITH ACTIVATED CARBON
- INSTALLED 15 TONS OF SILICA GEL







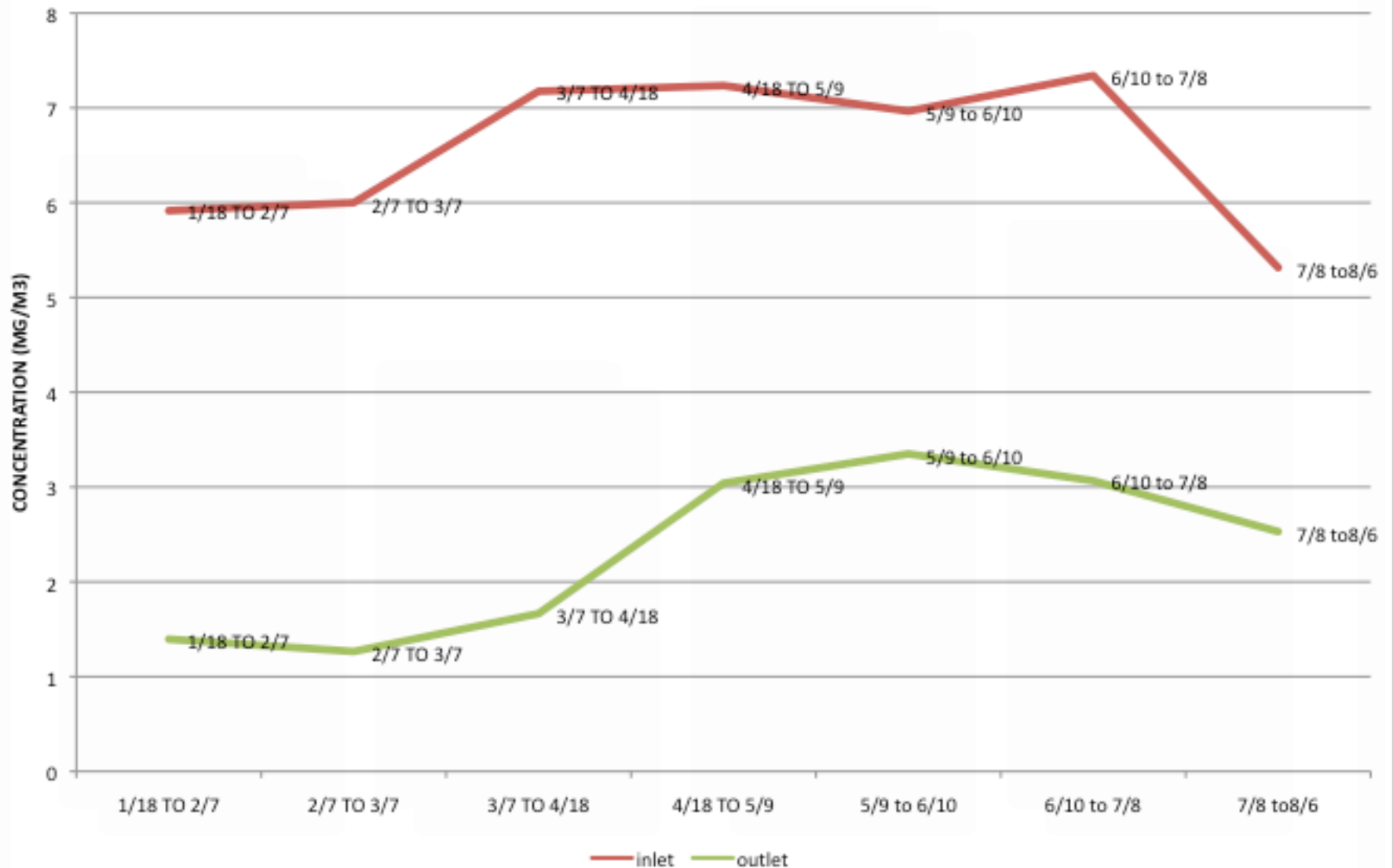
MEDIA DISPOSAL

- SPENT MEDIA LANDFILLED ON SITE
- REQUIRED A TCLP TEST AND PASSED
- A VAC TRUCK REMOVED AND HAULED THE MEDIA

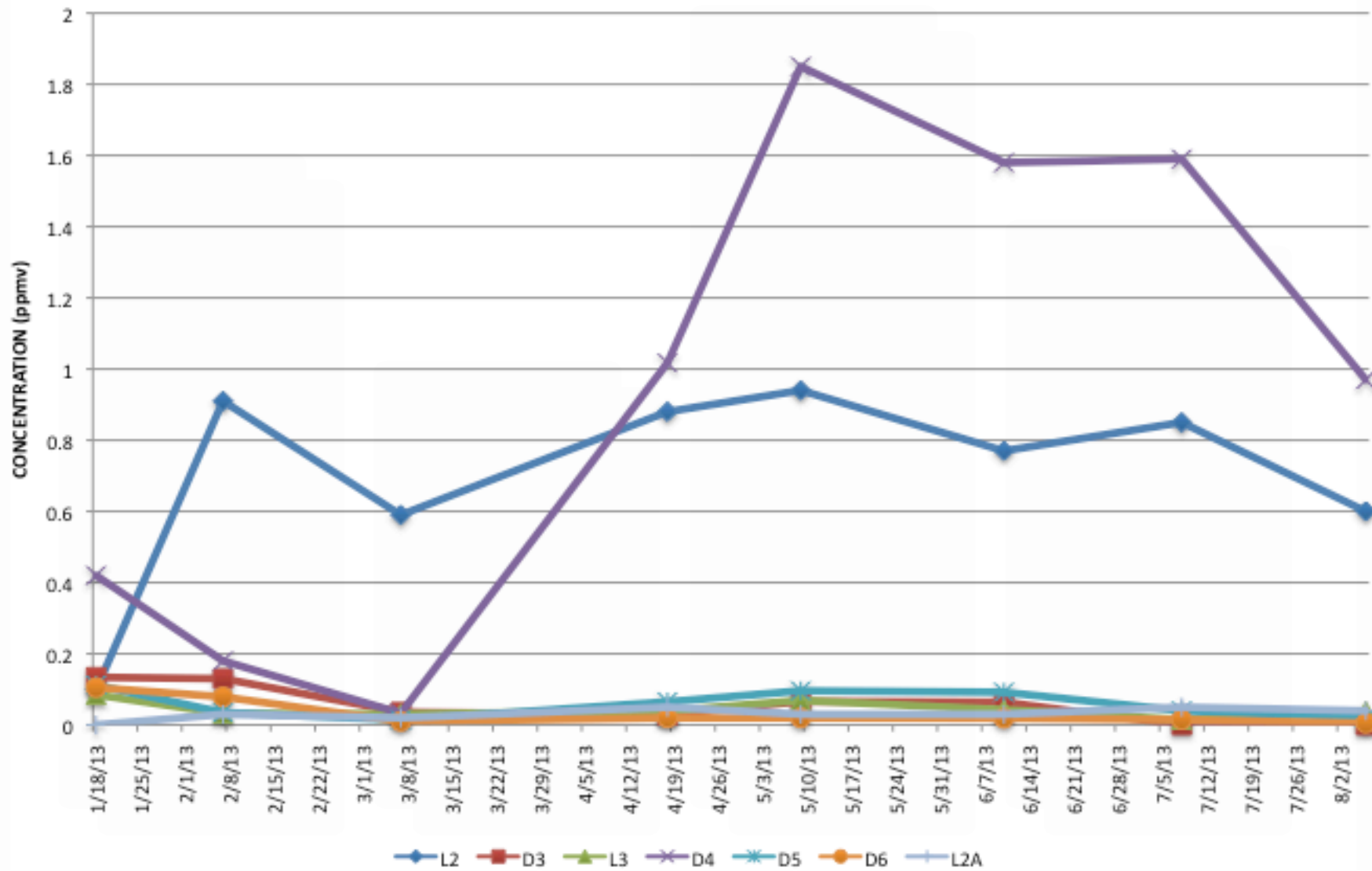


HOW DID IT PERFORM?

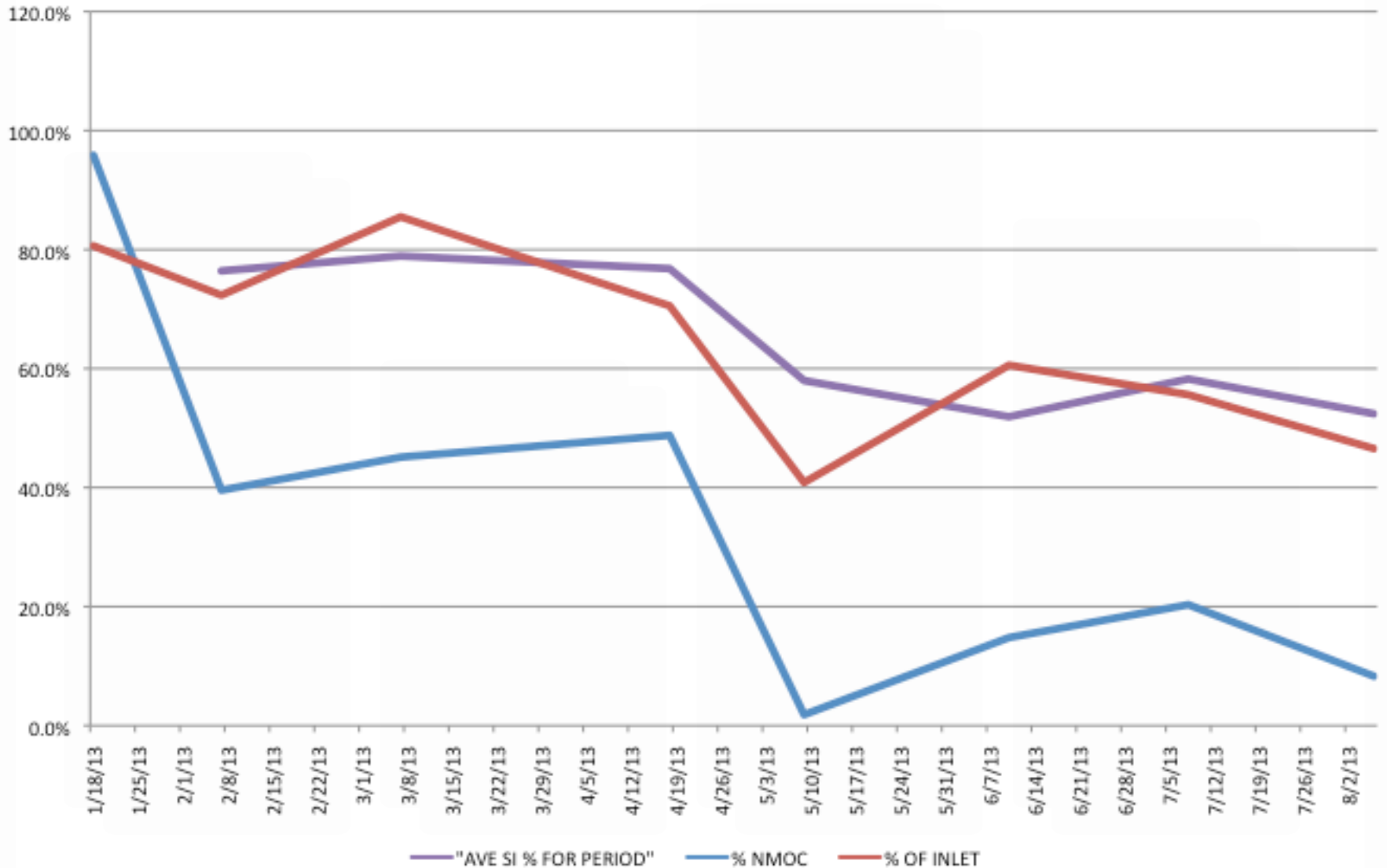
AVERAGE INLET & OUTLET BETWEEN SAMPLES



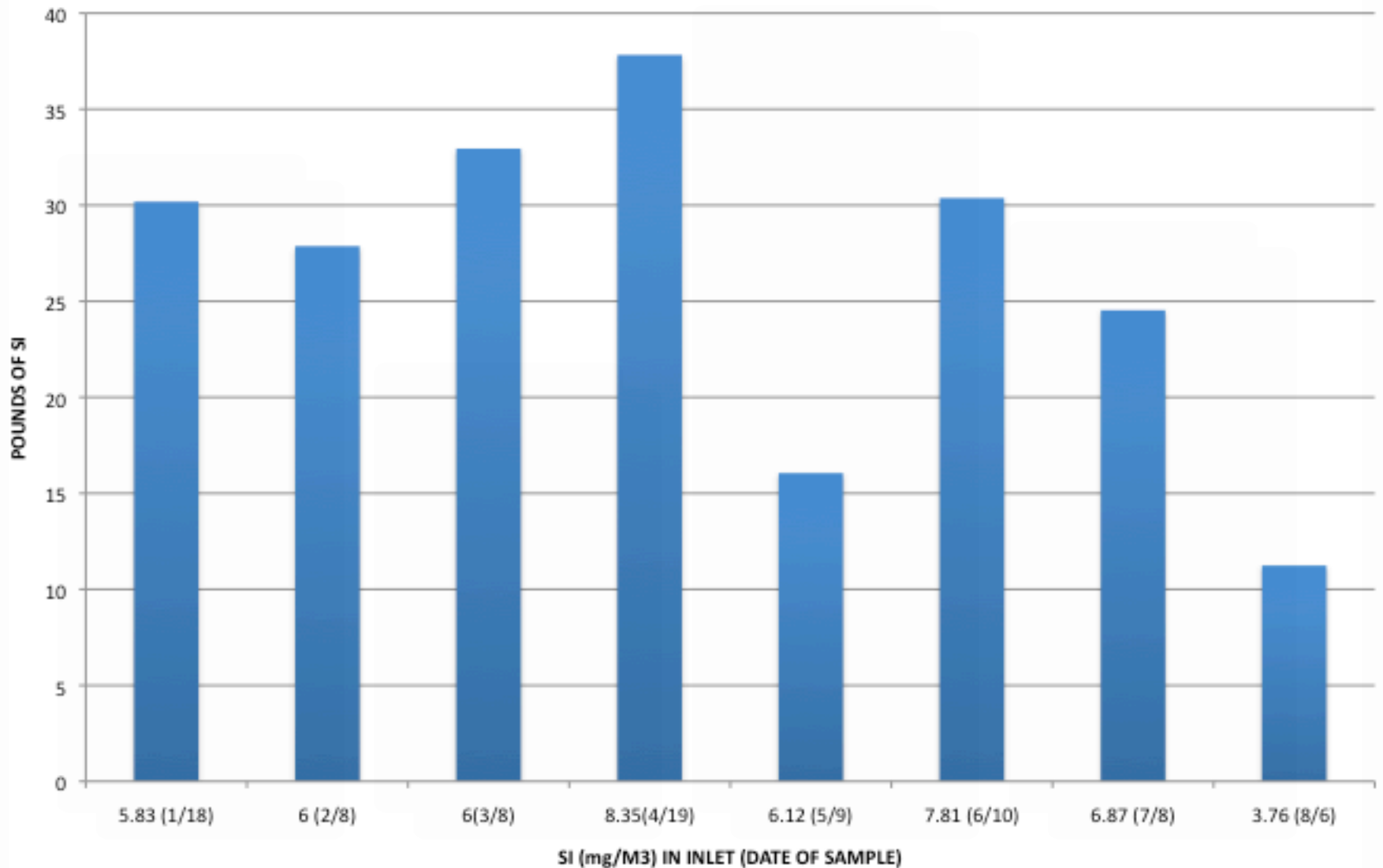
PPMV - SILOXANE SPECIES IN OUTLET GAS



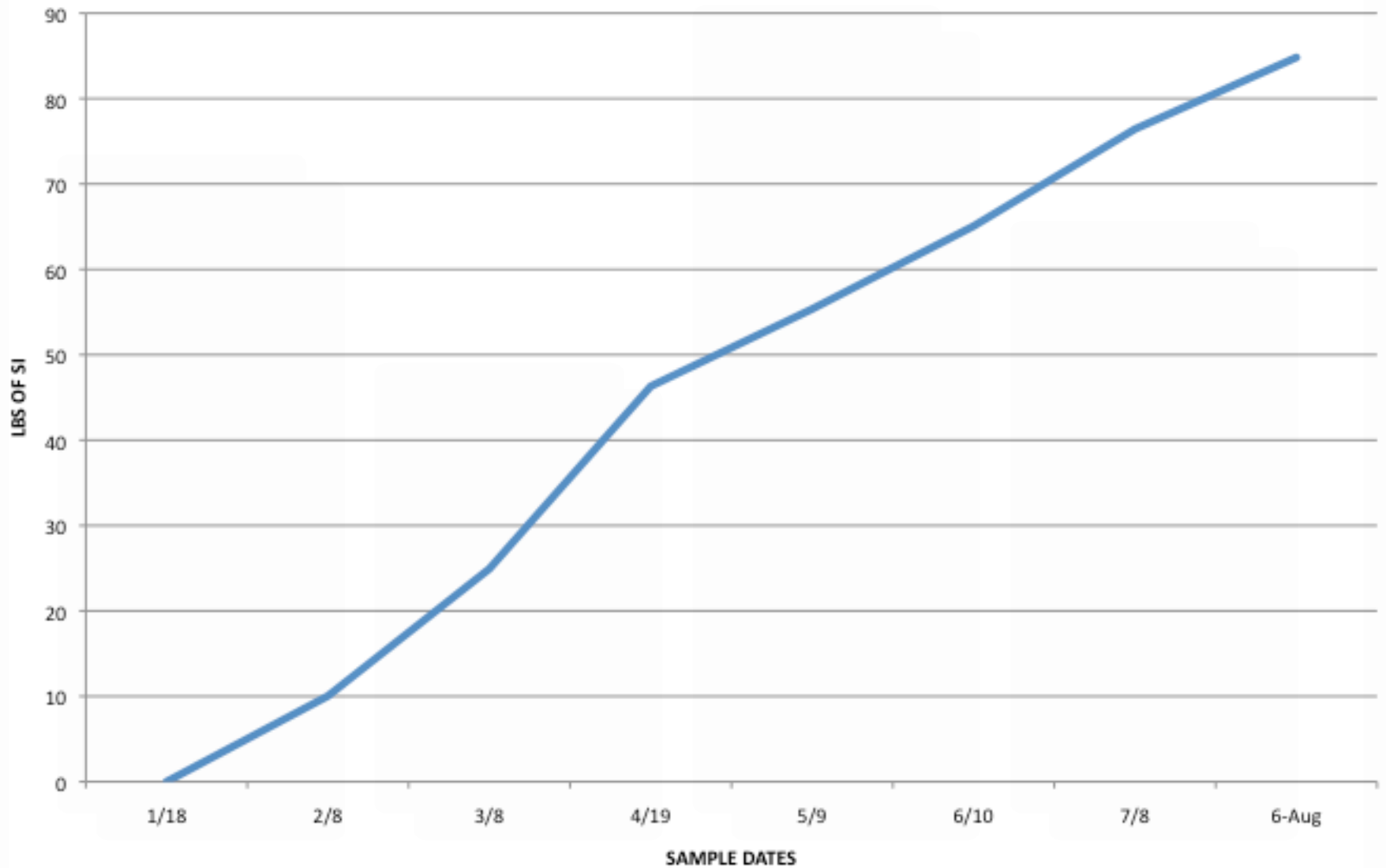
SI REMOVAL AS A % OF INLET (mg/m3)



SPOT RATE OF ADSORPTION (LB/100 MMSCF)



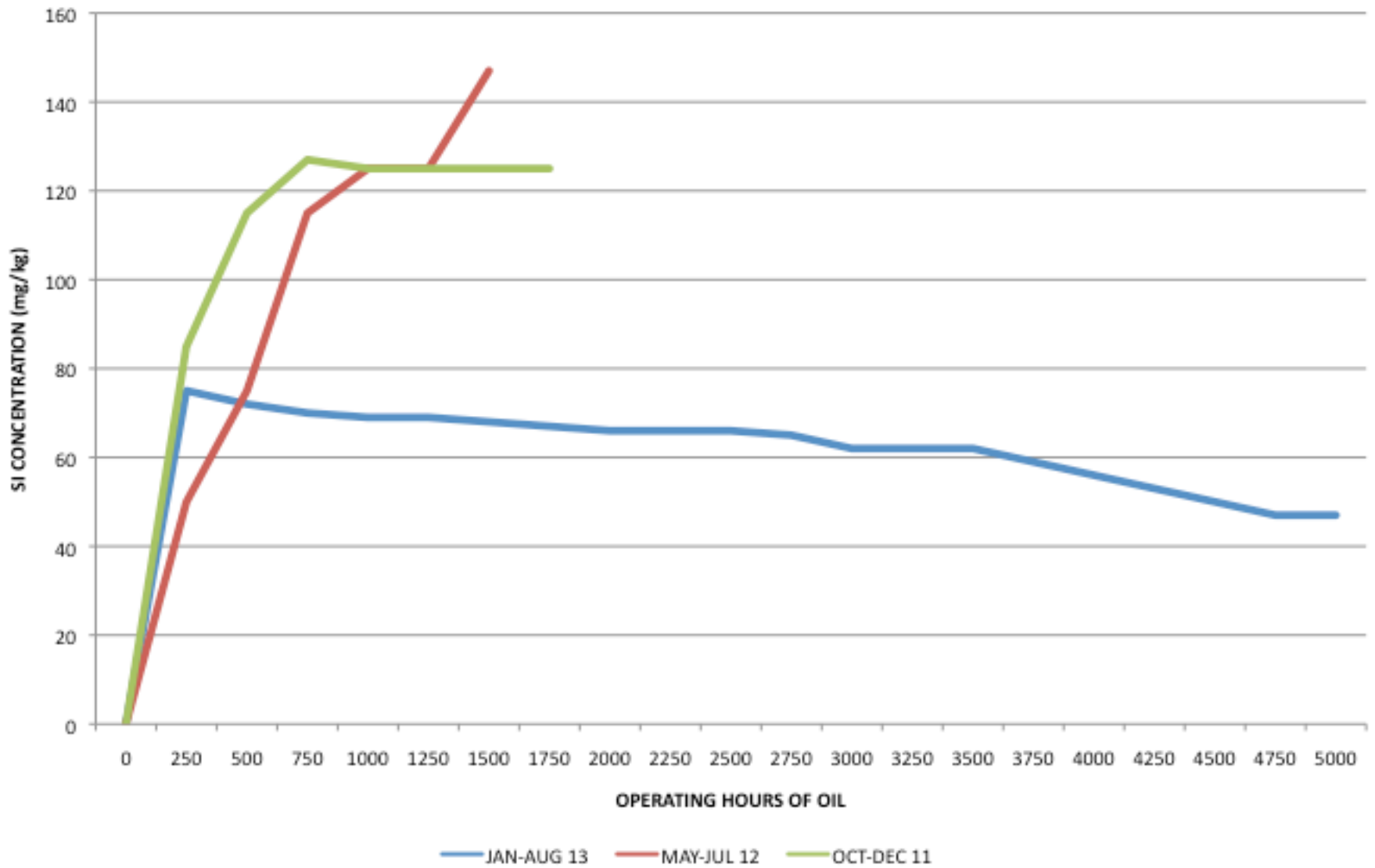
CUMMULATIVE LOADING (LBS OF SILOXANE)



SILOXANE REMOVAL

- INITIAL CHARGE OPERATED FOR 7 MONTHS
- STILL WORKING AT A LESS EFFICIENT LEVEL
- THERE WAS SOME BUILD UP BUT NOT DISRUPTIVE TO ENGINE OPERATIONS

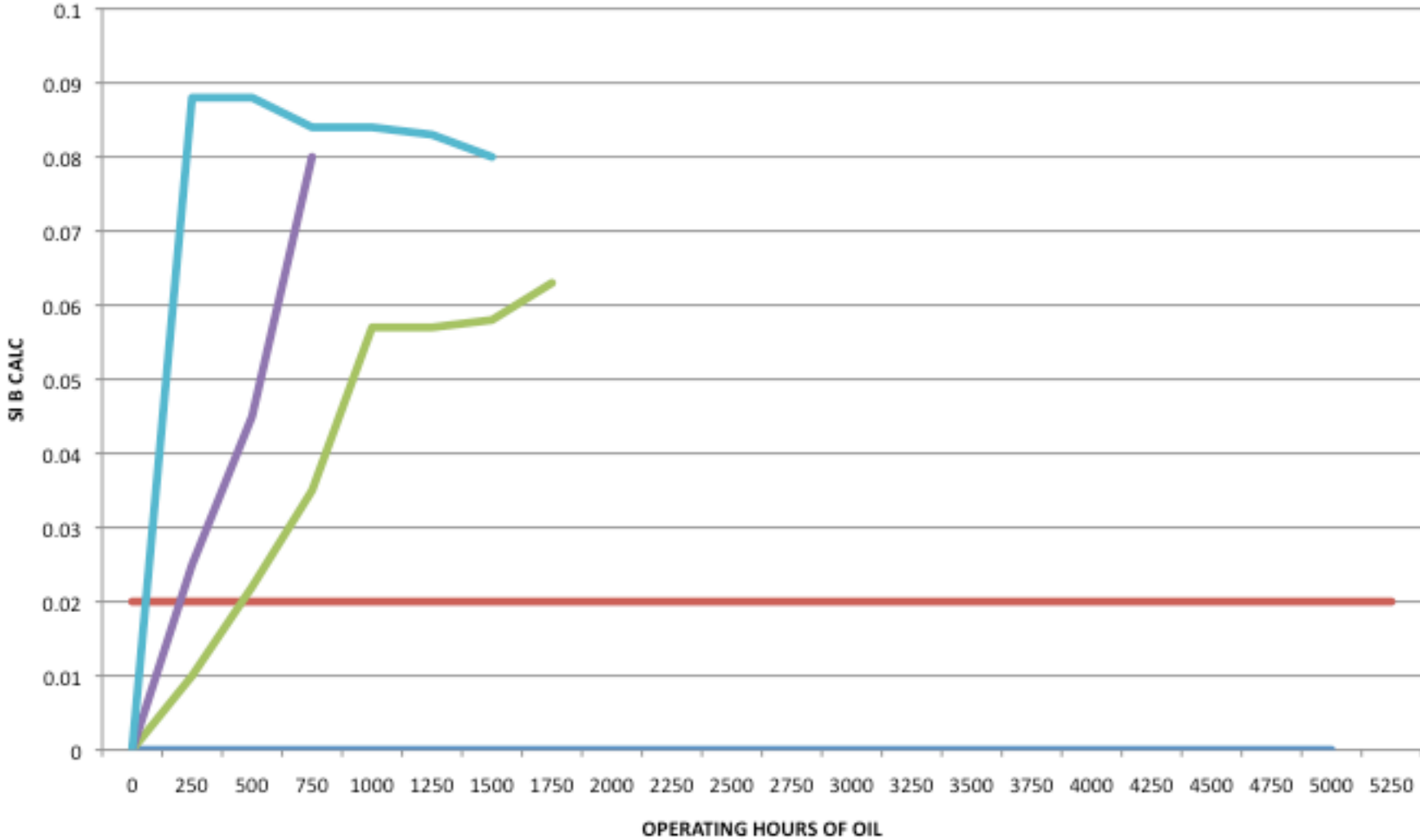
SI LEVELS IN OIL ANALYSIS (UNIT 1)



GEJ SI B CALC

GE JENBACHER CALCULATES THE RATE
OF SI BUILD UP IN THE OIL
TO DETERMINE IF
THERE IS AN ISSUE.

GE JENBACHER SI OIL CALCULATION



"JAN-AUG 13" LIMIT OCT-DEC 11 11-Jan MAY - JUL 12

OIL LIFE

- GREATLY INCREASED OIL LIFE
- EVEN GE JENBACHER IS HAPPIER

GAS QUALITY

	SITE 1	SITE 2	MFGR. SPECS
SILCONS (PPMV)	9	9	9
METHANE	40%	57%	50%
BTU/SCF	400	570	500
HEAT RATE (HHV)	11500	10600	9312
SI LOADING (PER KWH)	259	167	168

LESSON LEARNED

- NEED TO LOOK AT MORE THAN JUST THE SILICON LEVELS IN THE GAS
- NEED TO SEE THE MASS PER MWH

COSTS

- TOTAL INSTALLED CAPITAL \$305,000
- COST OF MEDIA PER EVENT \$35,000
- ANNUAL MEDIA COST (7 MONTHS) \$60,000

ANNUAL SAVINGS

• DECOKING (2 PER YEAR)	\$75,000
• PLUGS (2000 TO 5000 HR)	\$40,000
• OIL (1200 TO 5000 HR)	\$40,000
• PARTS & LABOR (MISC.)	\$10,000
•	
• TOTAL SAVINGS	<hr/> \$165,000

INCREASED REVENUE

• AVOIDED DOWNTIME	328 ENGINE HOURS
• OPERATING LEVEL	1.4 MW
• PRODUCTION	460 MWH
• PRICE (AVE)	\$80 PER MWH
•	
• TOTAL ANNUAL	<hr/> \$36,800

PAY BACK

- SAVINGS & REVENUE \$202,000
- COST OF MEDIA \$ 60,000
-
- NET ANNUAL BENEFIT

\$142,000
- PAYBACK (305,000/142,000) = 2.14 YEARS

CONCLUSION

- CONSIDER SILOXANE REMOVAL RATHER THAN INCREASED MAINTENANCE FOR A SMALL FACILITY
- INTERESTING STUDY TO EVALUATE THE DIFFERENT SPECIES OF SILICON NOT JUST THE TOTAL
- NEED MORE THAN GAS ANALYSIS TO EVALUATE POTENTIAL SILOXANE PROBLEMS