

Evaluating the Long-Term Performance of Composite Wear Rings in Centrifugal Pumps

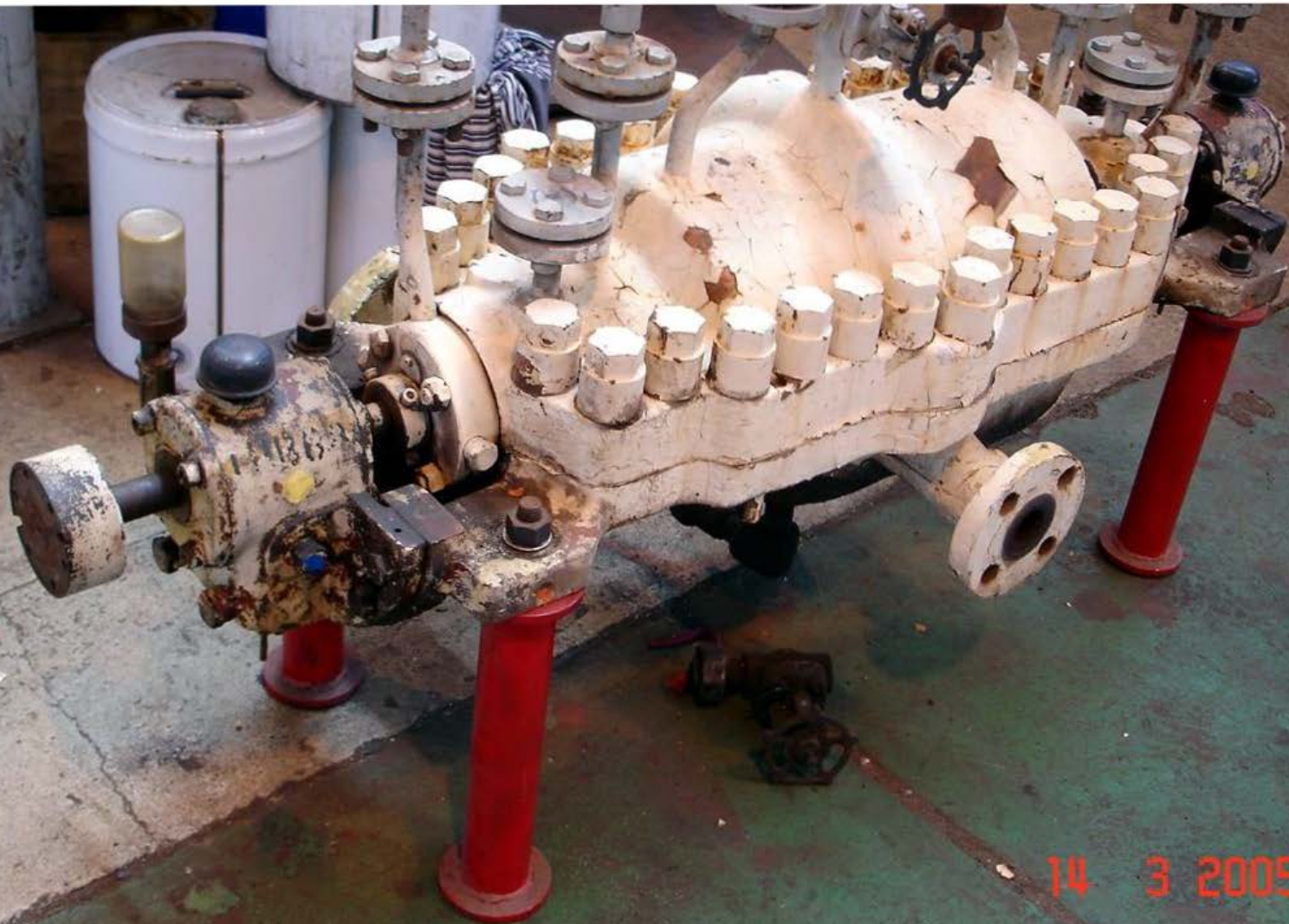
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Background

- Refinery instituted a standardization program to install composite wear rings with reduced clearance into a large population of pumps
- Purpose of study was to improve pump reliability
- Study was conducted on first 61 pumps upgraded
- Criteria was pump services < 500 F, refined product, chemical, or utility service (no bottoms or slurries)
- Details of installation, operating conditions, and preliminary results were published at 2007 International Pump Users Symposium
- This Case Study provides long-term results after more than 4 years of running time

Purpose: Improve Pump Reliability



14 3 2005

Material Selected: PFA/CF Composite



Trade name: DuPont™ Vespel® CR-6100

Installation Practice

- Stationary parts converted to composite
- Rotating parts metal
- Clearance Reduced to 50% of the API610 Minimum
- Composite part installed with press-fit and shoulder on low-pressure side
- No special retaining pins or screws used



Definitions

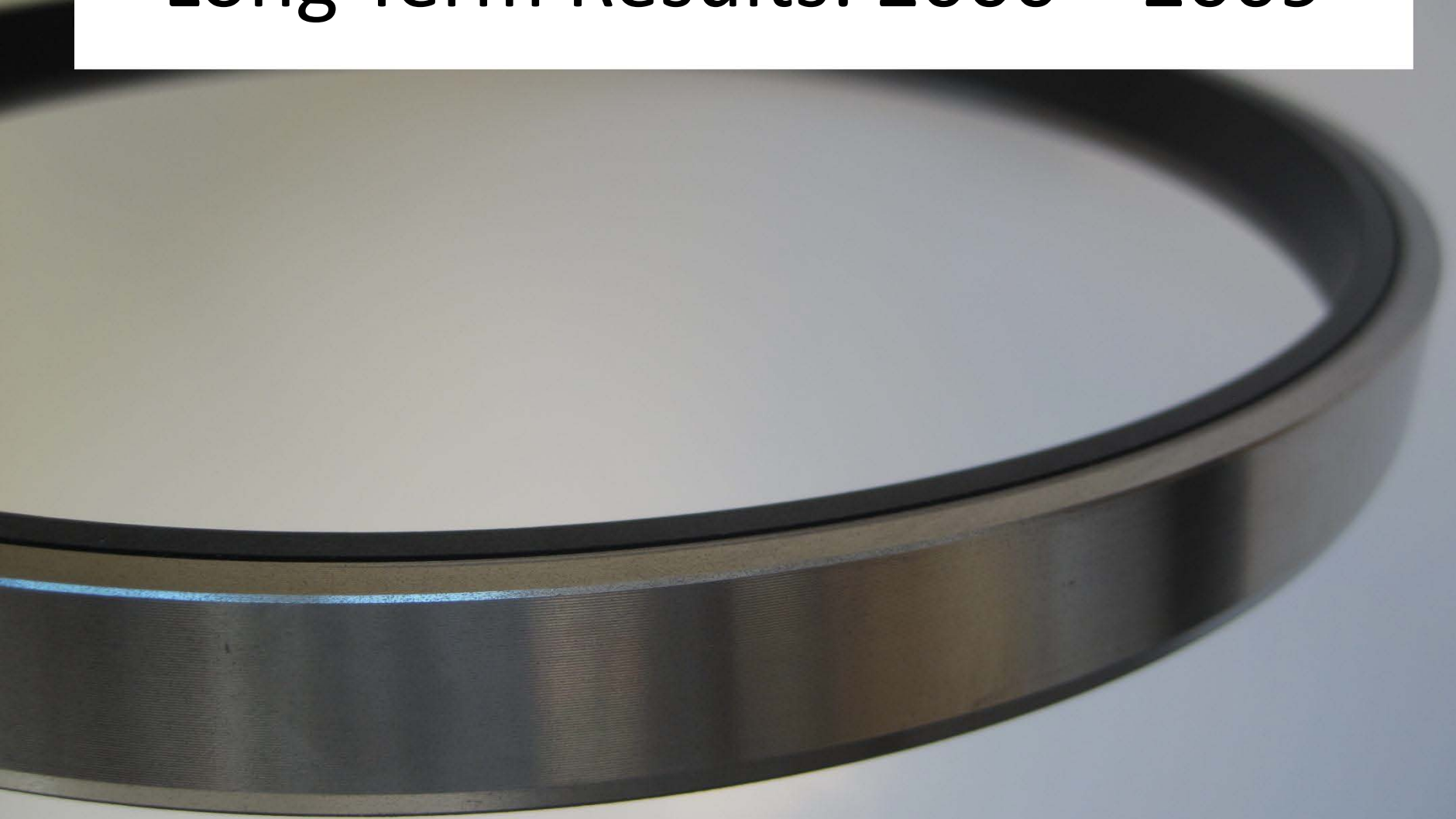
Repair	Any work performed on the pump that cost money and was recorded as a work order in the plant maintenance management system—including seals, bearings, vibration issues, wear ring seizure, inability to make rate, etc...
Overall Vibration	Average of overall vibration readings in inches per second (ips). It is the average of 111 data points from the 25 horizontal pumps within the study population.
LDAR Seal Leaks	Seal leakage which exceeds limits set by the site Leak Detection and Repair (LDAR) program, which monitors single mechanical seals in VOC (volatile organic compound) services. 12 pumps within the study population were subject to LDAR testing.

Results from Original Study 2003—2006

Factor Studied	Change
Number of Repairs	45% Reduction
Overall Vibration	25% Reduction
LDAR Seal Leaks	70% Reduction

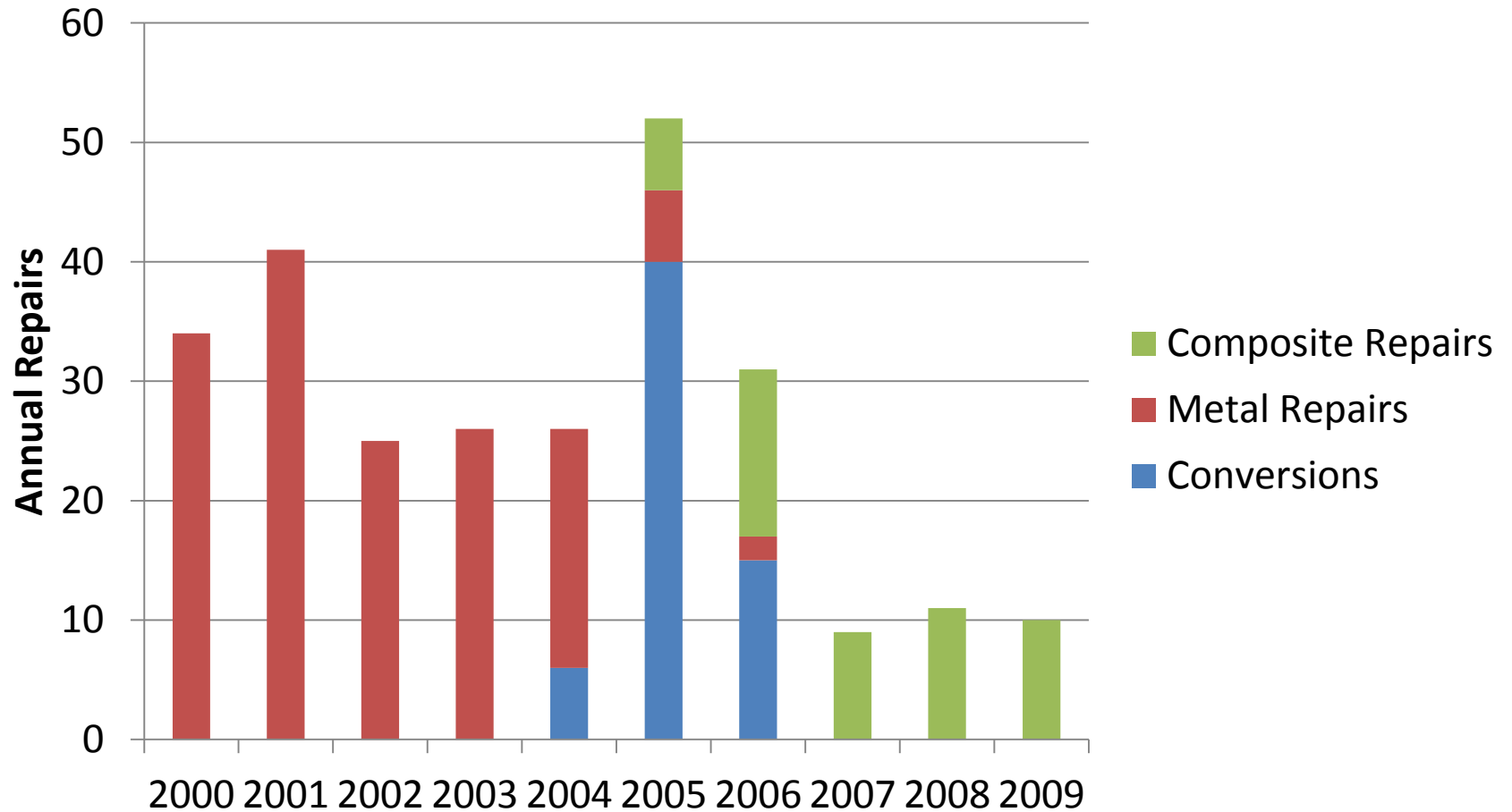
*Source: Aronen, R., Boulden, B., and Russek, M., 2007, "Driving Pump Reliability Forward with Advanced Composite Wear Rings," *Proceedings of the 23rd International Pump Users Symposium*, Turbomachinery Laboratory, Texas A&M University, College Station, Texas, pp. 15-19.

Long Term Results: 2000—2009



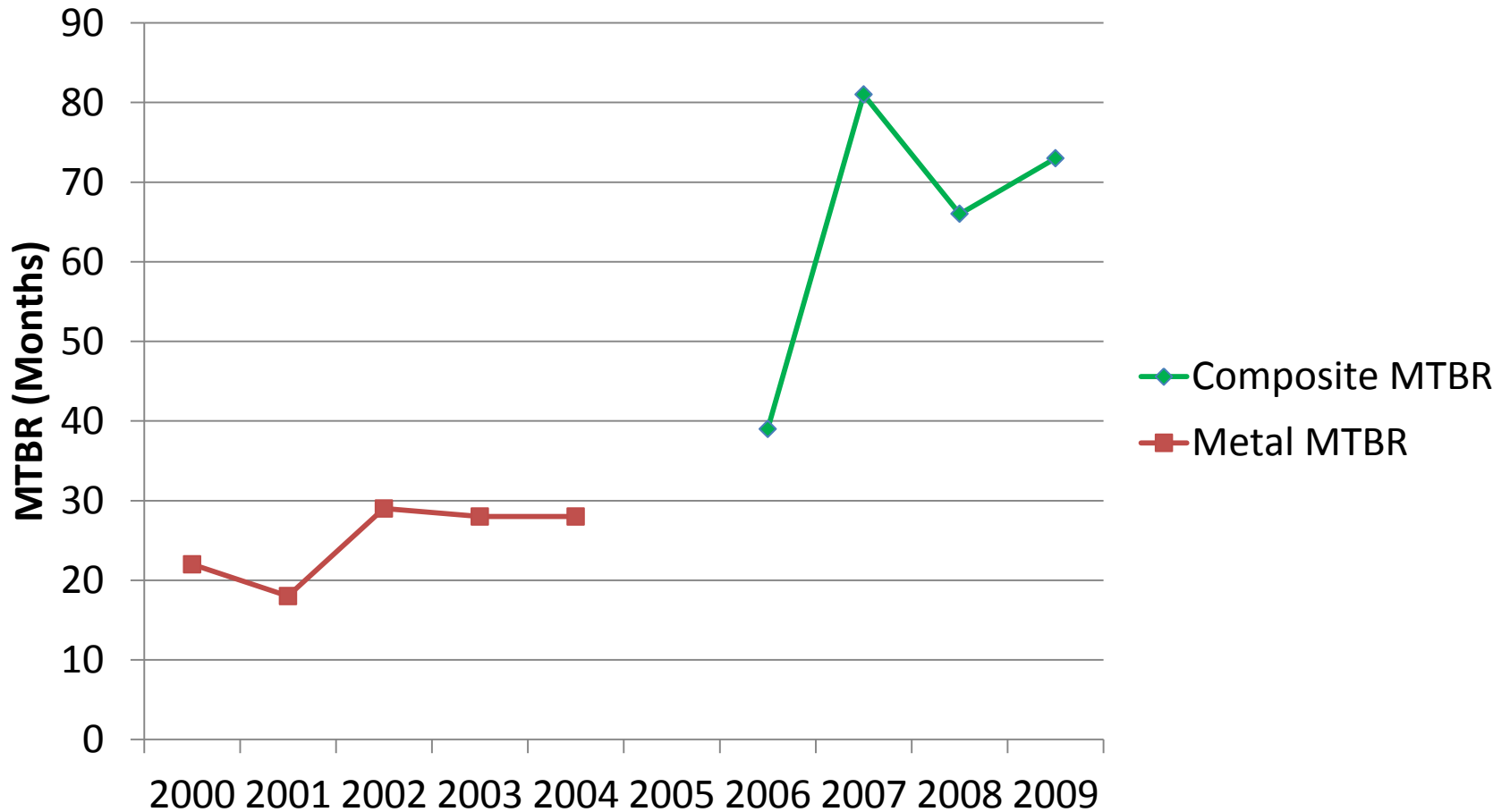
Annual Repairs

(Population 61 Pumps)



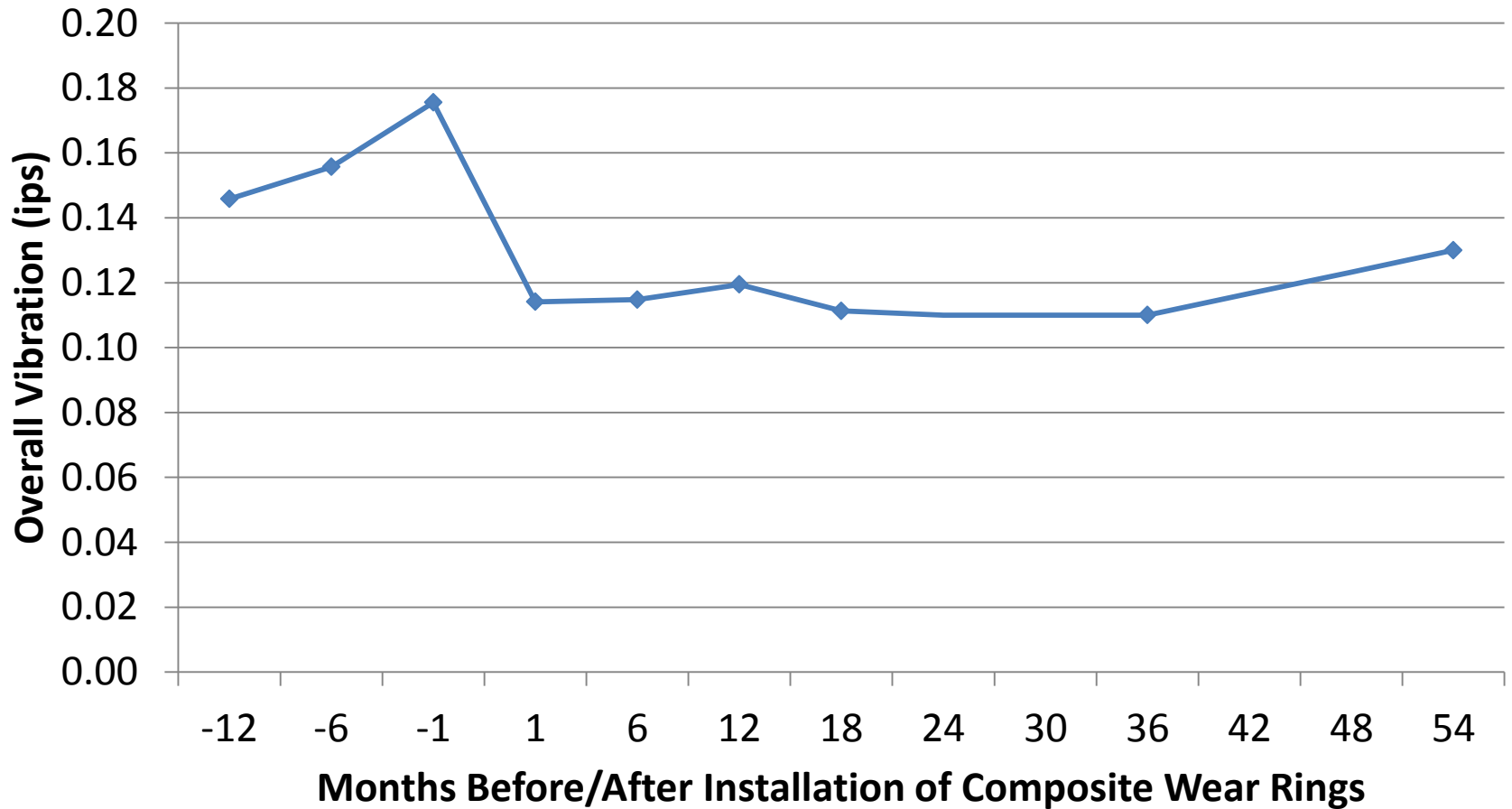
MTBR Before and After

(Population 61 Pumps)

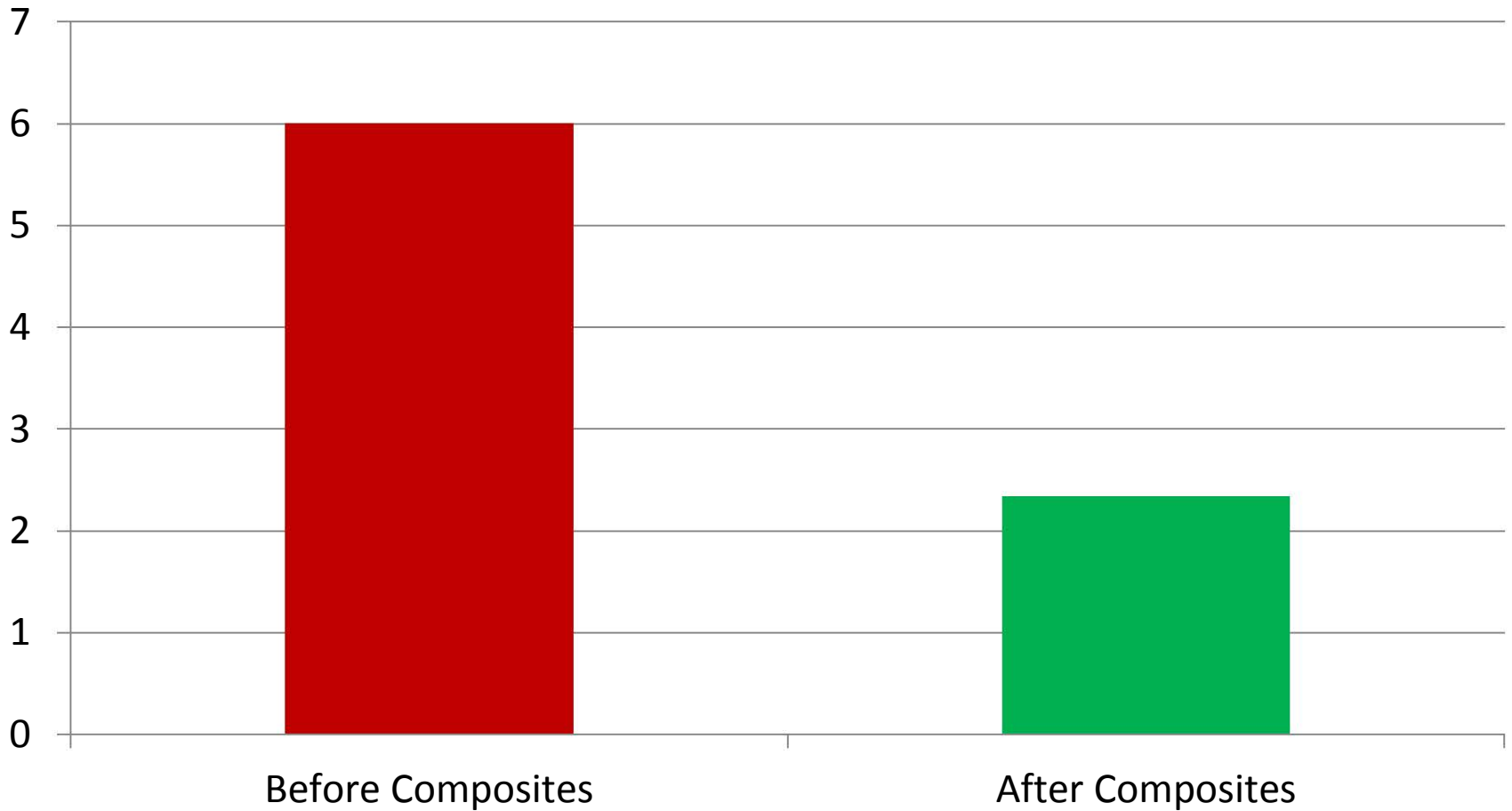


Overall Average Vibration Trend

(Population 25 Horizontal Pumps)



Annual Seal Leaks in VOC Service (Population of 12 Pumps)



Horizontal Multi-Stage



# of Pumps	Repairs Before	Repairs After	% Improvement
8	20	5	300%

Horizontal Single-Stage



# of Pumps	Repairs Before	Repairs After	% Improvement
31	43	35	23%

Vertical Multi-Stage



# of Pumps	Repairs Before	Repairs After	% Improvement
3	6	0	N/A

Vertical Single-Stage

# of Pumps	19
Repairs Before	39
Repairs After	8
% Improvement	388%



Limitations

- In 2005 and 2006 there were some repeat repairs—failure soon after start-up due to mechanical interference from reduced clearance
- Lesson learned was that reducing clearance requires superior concentricity of pump assembly
- Vertical pump bushing minimum clearance was also adjusted to be 0.002” (0,05 mm) larger than 50% of API minimum to avoid assembly issues

Conclusions

- Composite upgrade program proved very effective at improving pump reliability
- Repairs, vibration levels, and seal leaks were all substantially reduced
- Reducing clearance required adjustment to standard repair practice to require superior concentricity
- Several pumps which were previously “bad actors” have run more than 5 years with zero failures
- Multi-stage pumps and pumps with start/stop operation showed the largest reliability improvements