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EnVibe Five-Year PdM Program Case History— Single Plant Overall Data

Over a period of five years, EnVibe's Equipment Reliability Group developed a Vibration Survey and Condition-Based Predictive Maintenance Program for a large plant in the Houston area. On the next two pages, you will find two graphs which contain the overall vibration data from the entire period. Supporting data tables are found below each graph displaying the vibration levels from the five different units which made up the plant. Graph #1 shows all data measured in Velocity Pk while Graph #2 shows data from the same machines measured in Acceleration Pk. The Velocity data are used to evaluate the low to midrange frequency responses associated with unbalance, misalignment and structural issues. The Acceleration data are used to evaluate the high frequency responses associated with bearing deterioration and gearbox faults.

Prior to implementing the plant PdM program, machine faults went undetected by existing in-plant Preventative Maintenance practices and were only repaired when a problem became obvious or after a catastrophic failure. General equipment unreliability was the norm. However upon implementing our program, we made significant improvements and combated expensive outages and down-time by reducing vibration levels and predicting faults so that machine outages could be coordinated and managed. Through the five year period we evaluated each piece of machinery and established baseline vibration standards and parameter sets. This trend knowledge of the machinery helped us determine when to repair the equipment and also let us develop alerts and alarms; thus, preventing unnecessary and premature repairs which often result from a Preventative Maintenance Program.

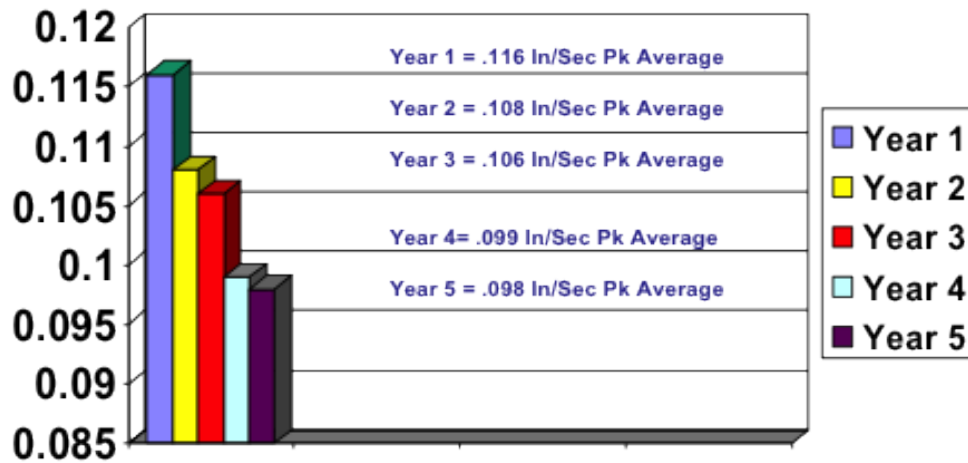
Periodically, we generated a vibration index report that allowed us to calculate an overall average amplitude of each machine, each area and for the total plant. This report was designed to provide management with a general indication of how the predictive maintenance program was performing. The report gave — in one number — the amount of “overall” vibration in the plant for a specific period. As you may suspect, a lower number demonstrates a healthier plant.

As you review the graphs and tables on the following pages, you will see that vibration levels drop dramatically in the first years of the program as a “wave” of major “condition based” repairs, machine improvements and modifications are made. This decrease indicates that problem machines are identified and repaired. After the initial major decreases, the average vibration amplitude levels rate of reduction begins to level off indicating that the point has been reached where equipment is not only optimized for smoother operation but problem machines are fixed early in their failure cycle and operating faults are diagnosed and failures are predicted and prevented. With EnVibe's continued monitoring and corrective procedures, years 4 and 5 in Graph #1 and years 3, 4 and 5 in Graph #2 demonstrate how vibration levels are reduced to within what Plant Engineering Magazine states is a “World Class Rating” (overall plant averaged levels below .1 In/Sec Pk). Corresponding with the drops in vibration year over year, plant uptime and equipment reliability increases.

Finally, an example of the cost savings earned with EnVibe's program is the continued run time on the Oleflex REC compressor. Normally this unit would have been shut down on a Preventative Maintenance schedule (by the number of run hours). When we applied EnVibe's Condition Based technologies and knowledge, the unit was found to be operating well and was not shut down for the normal preventive maintenance procedures. This extended run time saved one week of down time and \$210,000.00 in revenue.

GRAPH 1

Five Year Amplitude Average Statistics
Entire Plant – Velocity In/Sec Pk Data

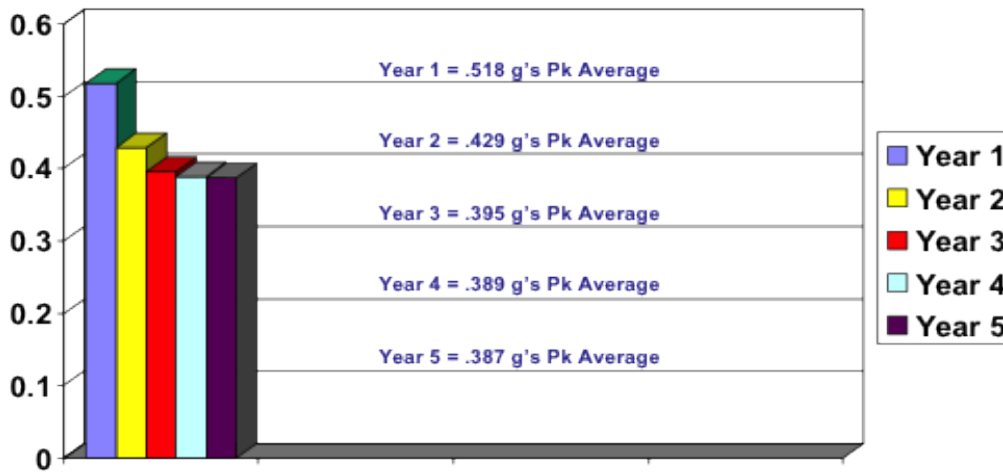


VELOCITY IN/SEC PK DATA TABLE

	Year 1	Year 2	Year 3	Year 4	Year 5
Butamer Area	.150	.136	.129	.121	.118
MTBE Area	.106	.117	.118	.101	.098
Oleflex Area	.137	.120	.116	.110	.110
Storage Area	.106	.091	.090	.087	.086
Utilities Area	.082	.080	.080	.079	.078
Totals	.581/5	.544/5	.533/5	.498/5	.490/5
Average	.116	.108	.106	.099	.098

GRAPH 2

Five Year Amplitude Average Statistics
Entire Plant – Acceleration g’s Pk Data



ACCELERATION G'S PK DATA TABLE

	Year 1	Year 2	Year 3	Year 4	Year 5
Butamer Area	.545	.479	.440	.420	.419
MTBE Area	.417	.389	.376	.373	.370
Oleflex Area	.890	.569	.485	.484	.484
Storage Area	.330	.272	.269	.267	.262
Utilities Area	.408	.437	.406	.404	.403
Totals	2.59/5	2.146/5	1.976/5	1.948/5	1.938/5
Average	.518	.429	.395	.389	.387