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Vibrational Analysis a Key for Pump Maintenance-Case Study

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Abstract: *The following case study is the result of the project work and research done by me at one of the major plant in AP. The case study is of a medium pressure water pump which had developed high vibrations. The causes of vibrations were identified using latest non destructive testing tools and corrective measures were implemented. The condition of the pump after the correction was checked and was found within acceptable healthy condition therefore pump was put to use.*

Keywords: *Bearing clearance, misalignment, unbalance.*

I. Introduction

The said pump was observed to be having undue vibrations during routine inspection of all the running equipments. The observation was recorded in the log book for conducting thorough condition monitoring before any major break down occurs. The preventive maintenance team requested for a shutdown of the said pump and subjected it to oil analysis, infrared analysis, oil particle analysis and vibrational analysis.

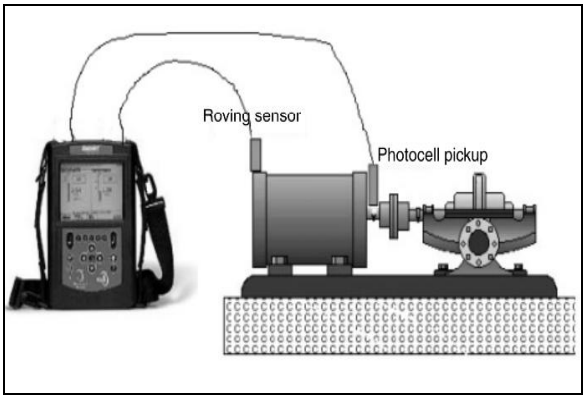
II. Identification Of Problem

The said pump was observed to be having undue vibrations during routine inspection of all the running equipments. The observation was recorded in the log book for conducting thorough condition monitoring before any major break down occurs. The preventive maintenance team requested for a shutdown of the said pump and subjected it to oil analysis, infrared analysis, oil particle analysis and vibrational analysis. But of all the techniques only vibrational analysis was able to give the answer. All the spectrum analysis of the pump with correction and without correction is given in the spectrum analysis section along with a table in case study section. Finally the paper will end with the spectrum of the healthy pump in running condition.

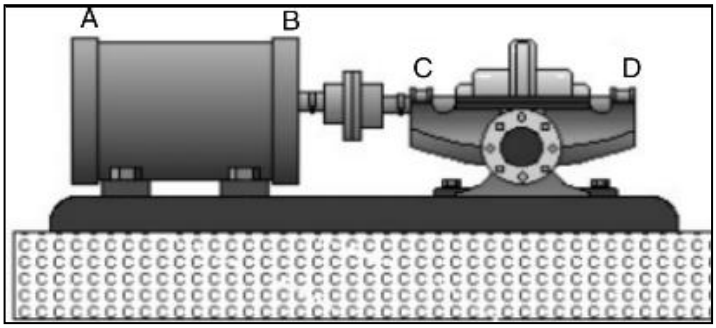
Centrifugal pump

Condition Monitoring System Implementation

TEST SETUP:



Vibration measurements should be taken at the inboard and outboard bearings of a pump and motor in axial, horizontal, and vertical directions. If a more intensive analysis is required, measurements also should be taken at several places on the pump base. Electronic probes or sensors can be attached at each of these locations, sending electronic signals to a vibration analyzer. Measurements should be taken at operating speed for constant-speed motors and at varying speeds for pumps operating on variable-speed drives.

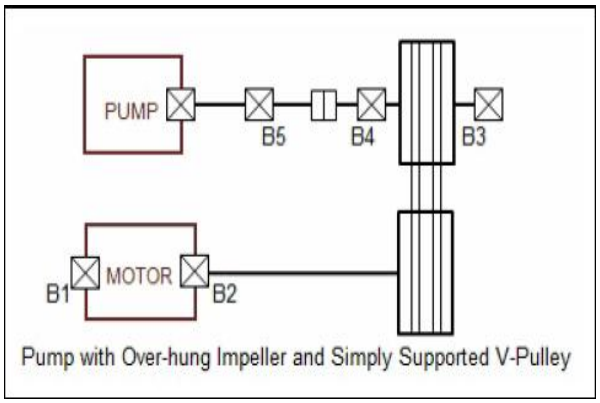


Motor non-drive end bearing – A
Motor drive end bearing – B
Pump outboard bearing (next to the coupling) – C
Pump inboard bearing (away from coupling) – D.
At all the above points the reading were taken and the values have been analyzed and included.

Case Study:

A motor with capacity of 200kw, 1490rpm is attached to a pump with 1853 rpm, suction pressure of 6 kg /cm2 , discharge pressure of 10 kg/cm2 ,flow rate of 600m3/hr was monitored regularly by CONDITION MONITORING.

The Layout is as given below:



Location of the above layout:

Equipment: Cellar-8, Pump-1.
Utility: Supplies Water for Tempcore Cooling and for cooling of rolling stands
Equipment Details:
Motor:
Rating: 200KW
RPM: 1490
Pump:
Flow: 600m3/hr
Suction Pressure: 6Kg/cm2
Discharge Pressure: 10 Kg/cm2
RPM: 1853

Problem:

It was found that one of plumber block bearing had indicated undue vibrations (9.8 mm /S2) in horizontal direction and generation of heat beyond acceptable limits.
The misalignment was then measured using dial gauge and actual correction of the shaft carried out till accepted limits.
The unbalance was detected due to the undue vibrations reaching more than the recommended value.

Data collection: At points b1, b2, b3, b4, b5 the reading were taken. The following is one of them indicating some problems.

Vibration on 06/1/2014 in (mm/sec- rms)					
	MNDE	MDE	PB1	PB2	Pump
V	3.8	3	3.5	2.5	1.7
H	2.3	4.1	5.3	9.8	3.7
A	2.7	4.5	3.1	5.3	2.2

The Overall Vibration of PLUMMER BLOCK B3 and B4 were high.

The Horizontal vibration of PB2 reached to a very critical value of 9.8mm/sec

Plummer Block.

The threats found were:

Bearing Clearance
Misalignment
Unbalance

Corrections:

All the corrections made on the pump are based on the vibrational analysis. The peaks were keenly observed and accordingly the corrections were made to bring the machine back to normal working condition. Both the peaks (i.e) the damaged , corrected(machine in normal condition) are included below.

Bearing clearance:

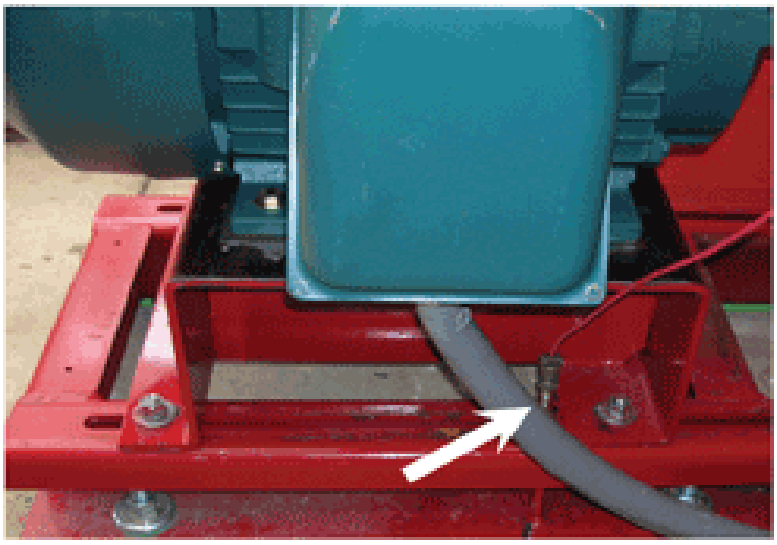
Correction: The bearing was opened and the shaft clearances were measured using precision vernier calipers where it was observed that the clearance was more than the allowed norms. This was corrected by providing an exact size copper shim between the wearing ring and the bearing cover. The bearing clearance was reduced by using shims.

Misalignment:

Correction: Misalignment was corrected by correcting parallel misalignment. The pulley shaft was realigned with the pump shaft.

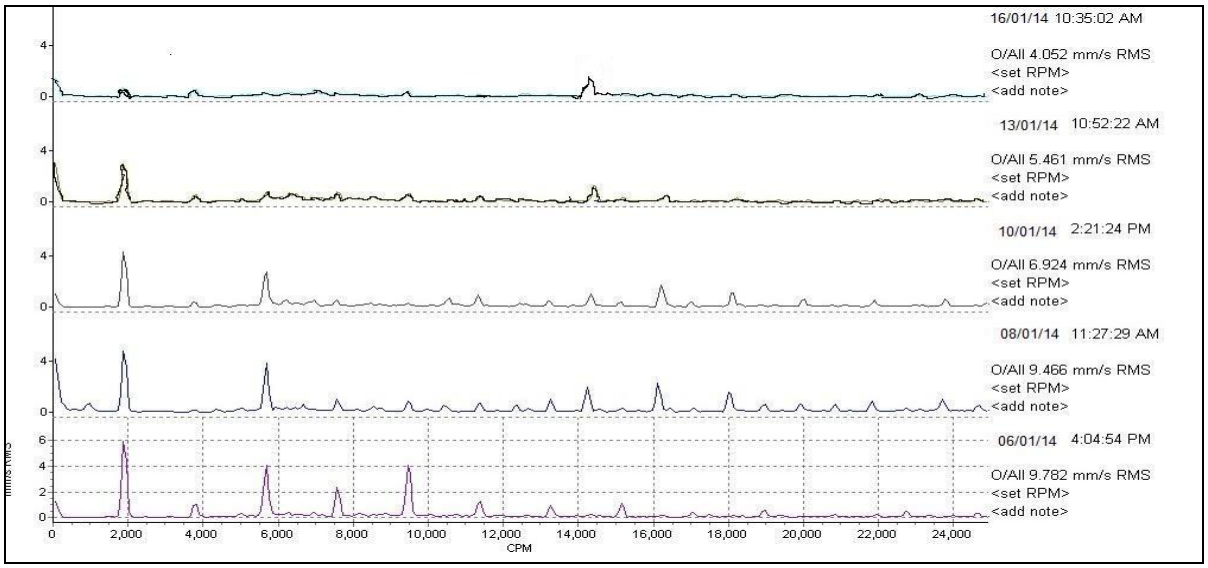
Unbalance:

Correction: Unbalance was corrected by adding weights to the pulley which would lead to balancing of equipment.

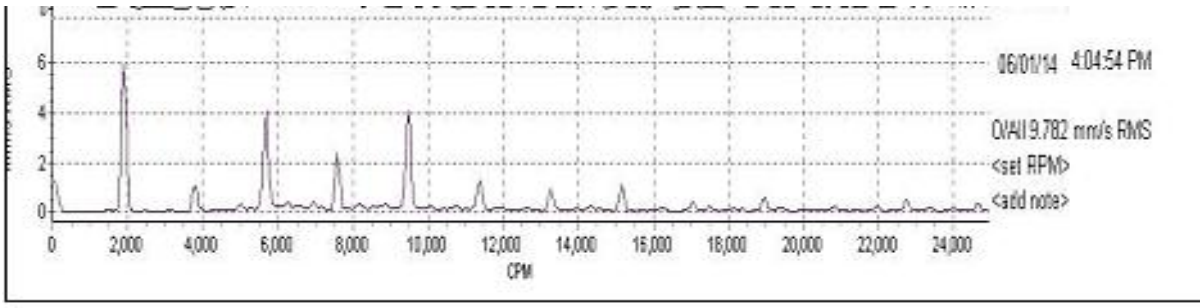


A Point for Vertical Measurement on a Pump Base

SPECTRUM ANALYSIS:



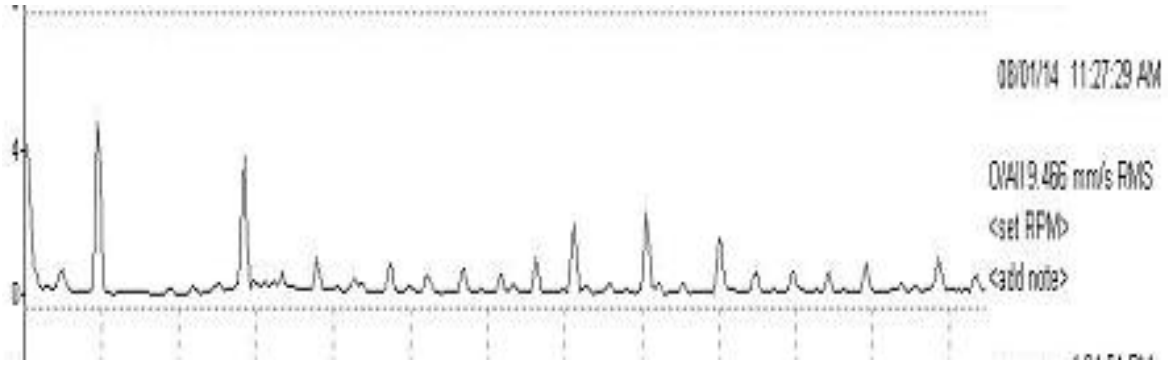
Observations:



The pump developed looseness due to the bearing clearance which was beyond the limit recommended.
On further study it was seen that it also developed misalignment.
On through study of spectrum we see that it has developed unbalance also.

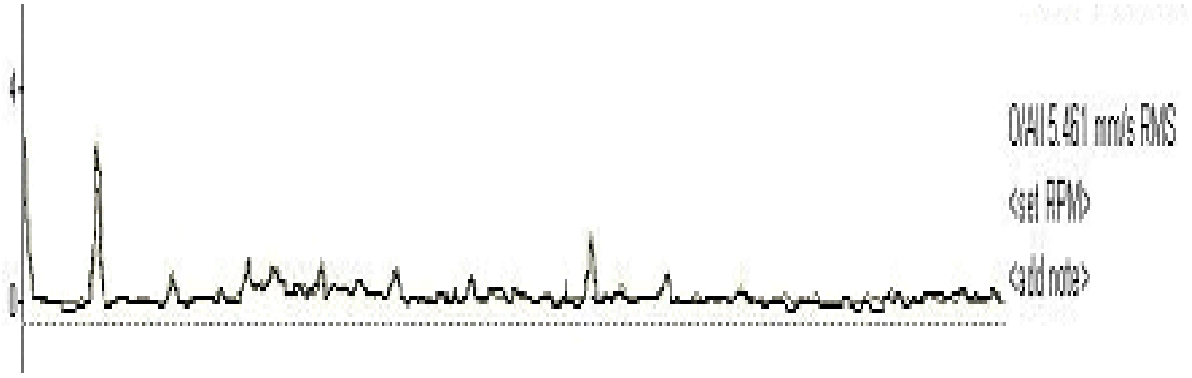
Corrections:

Bearing Clearance:



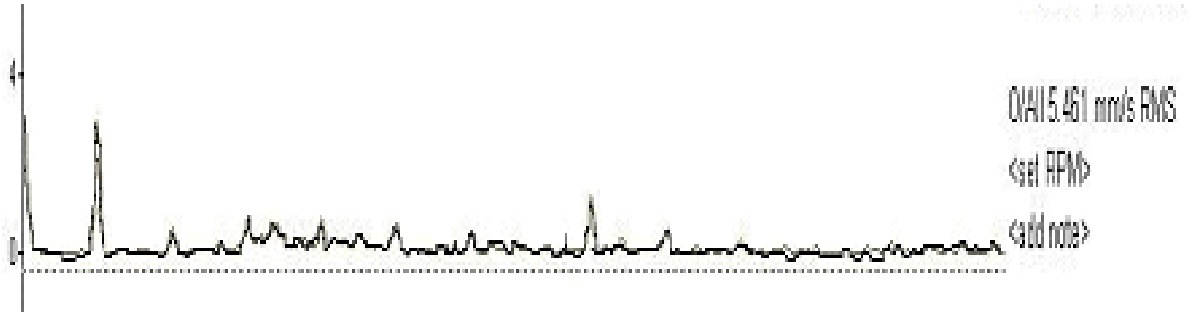
The peaks 2x, 4x,5x, 6x indicate mechanical looseness which is due to bearing clearance. The bearing clearance was corrected by the use of shims, due to this correction the rms value has not changed but the peaks 2x,4x, 5x, 6x etc. vanish, indicating that looseness has been eliminated.

Misalignment:



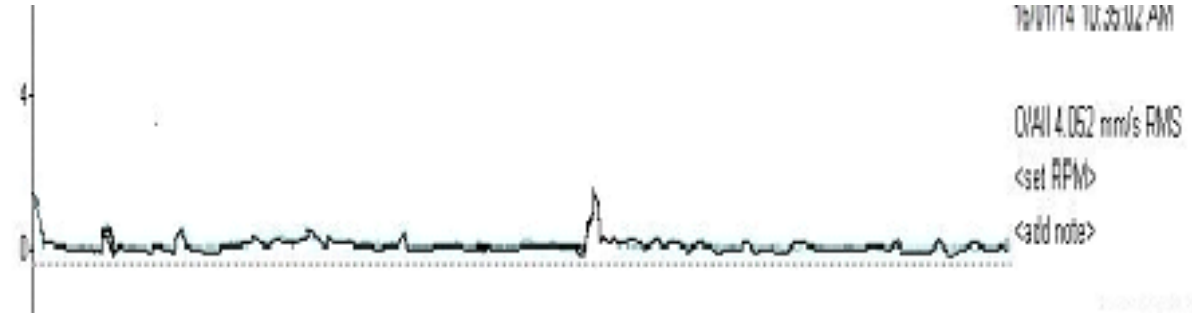
From the spectrum the peaks 3x, 1x indicate misalignment. So by radial adjustment/alignment of the pump shaft with the pulley shaft was done . By this, the rms value reduced from 9.466 to6.924 where the peak 3x vanishes and 1x has reduced.

Unbalance:



The Unbalance was corrected. The correction is done by balancing the pulley by adding weight to it. By this, the rms value shifts from 6.924 to 4.0 and the 1x peak vanished. The overall value has come below the norm.

Spectrum of the machine in normal condition (corrected spectrum):



Thus by performing all the above techniques using Condition Monitoring, the Equipment was protected from likely Breakdown.

III. Conclusion

A timely detection of problem and attending to by taking necessary corrective action prevent major break down and increasing productivity. Further I will continue to take projects and try to increase condition monitoring diagnostics and its cost effectiveness.

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