HI-SPEED INDUSTRIAL SERVICE QualiTest® Diagnostics

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September 28, 2023

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The following is a summary of findings from the August 2023 WEEK 4 vibration survey at the H2O2 Plant and the MONTHLY H2 vibration survey that was performed on September 22, 2023.

QualiTest® uses a four step rating system for defects.

CLASS I: Defect is present, but effect on reliability is not clear; no immediate action is required. Continue to normally monitor.

CLASS II: Defect (s) present that may cause problem in long term (2-6 months). Repair during normal maintenance scheduling. Continue to monitor.

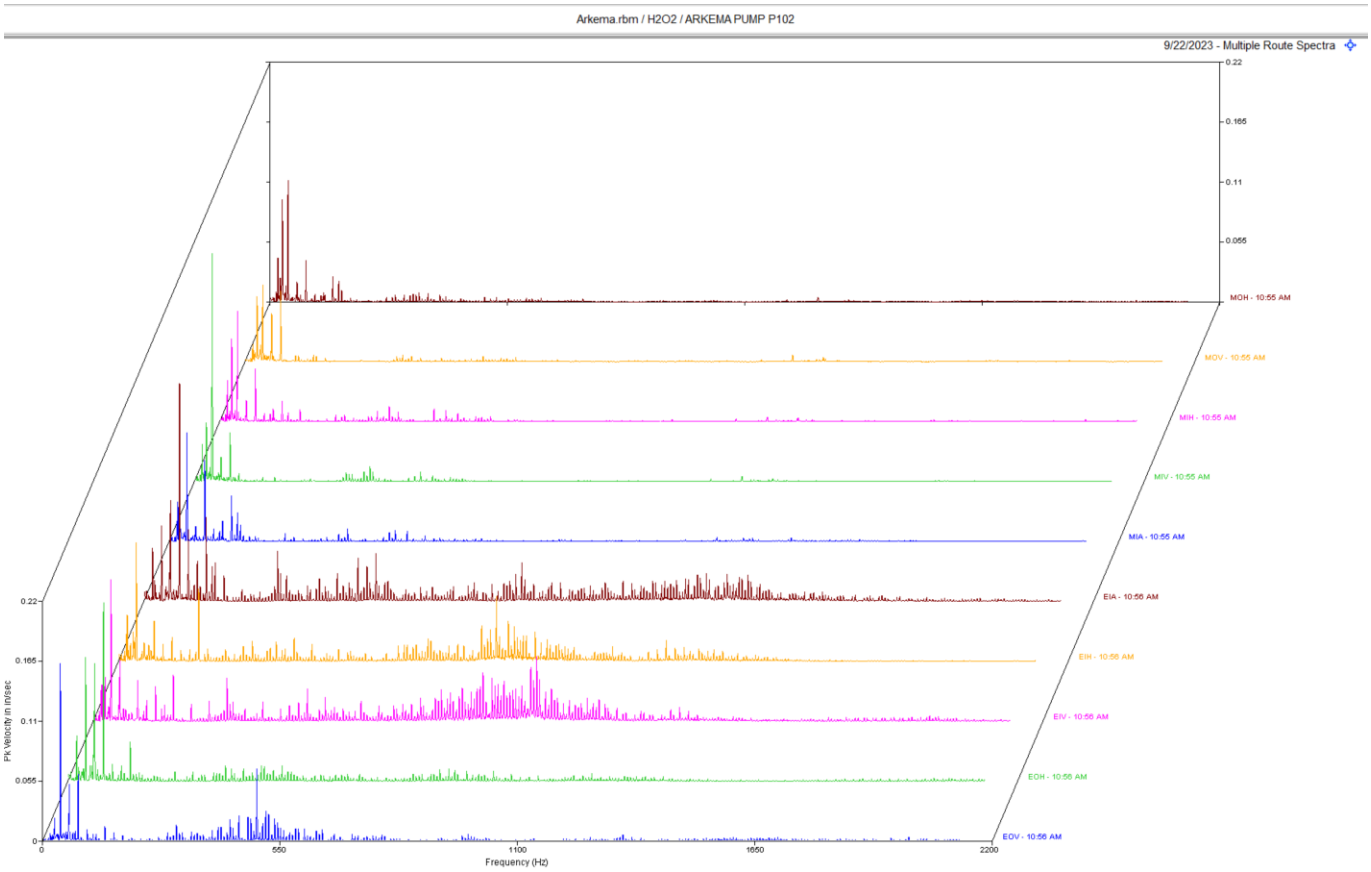
CLASS III; Defect (s) present that may cause failure in short term (less than 2 months). This should be addressed as soon as practical, with a high maintenance priority. Increase monitoring frequency.

CLASS IV; Defect (s) present that makes continued reliability unpredictable, and possibility of secondary damage is high. Repairs should be made ASAP. An unscheduled shutdown should be considered for repairs

Defect Summary

WEEK 4 H2O2 Plant

Pump 102 P102 CLASS I



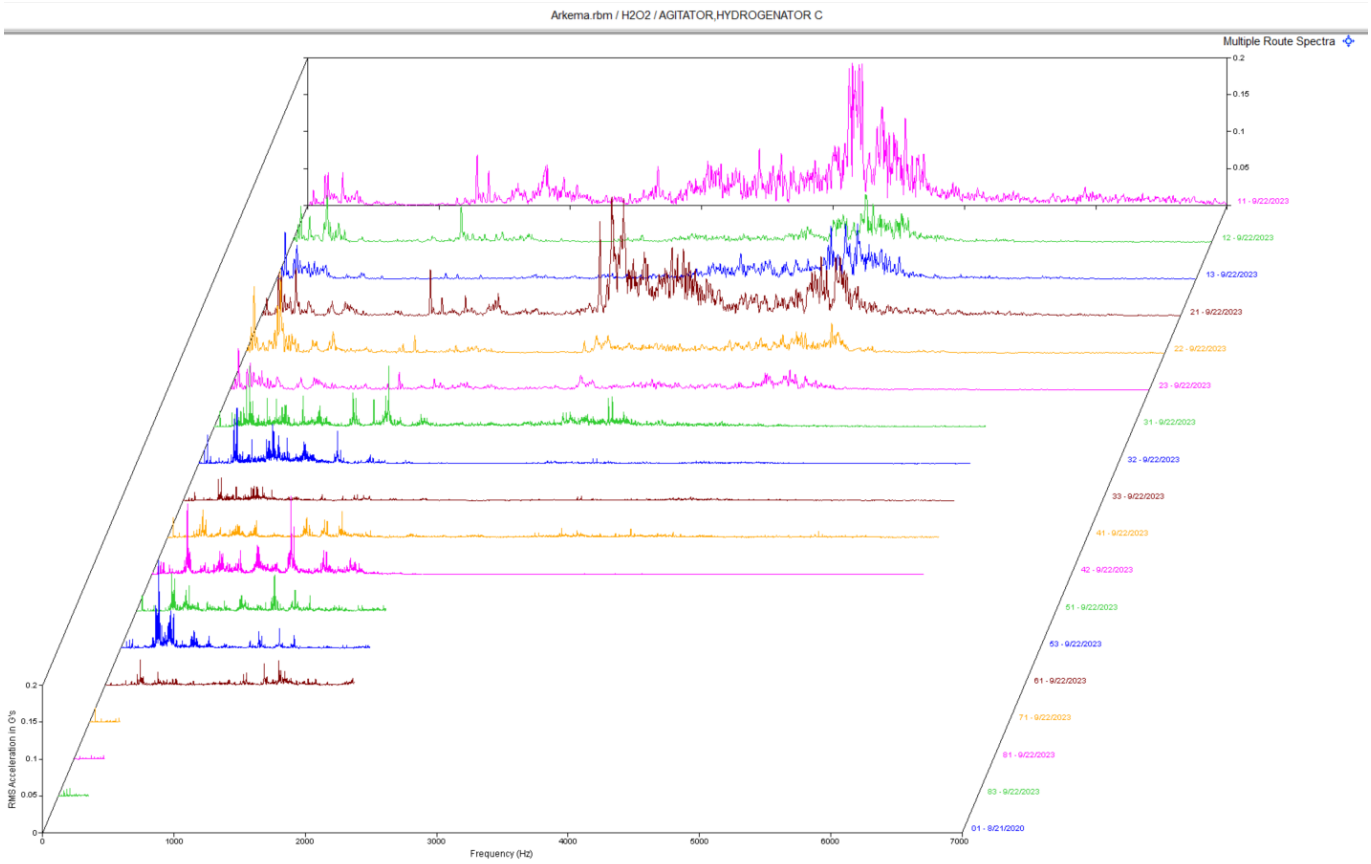
Observation:

Data above is a multipoint spectral waterfall. Pump data (EIA-EOV) shows axial vibration with multiple rpm harmonics throughout the pump spectra.

Recommendation:

The pump appears to have possible internal wear beginning to occur. The higher vibration in the axial direction may indicate excessive axial clearances. We are monitoring this very closely.

Agitator, Hydrogenator C CLASS I



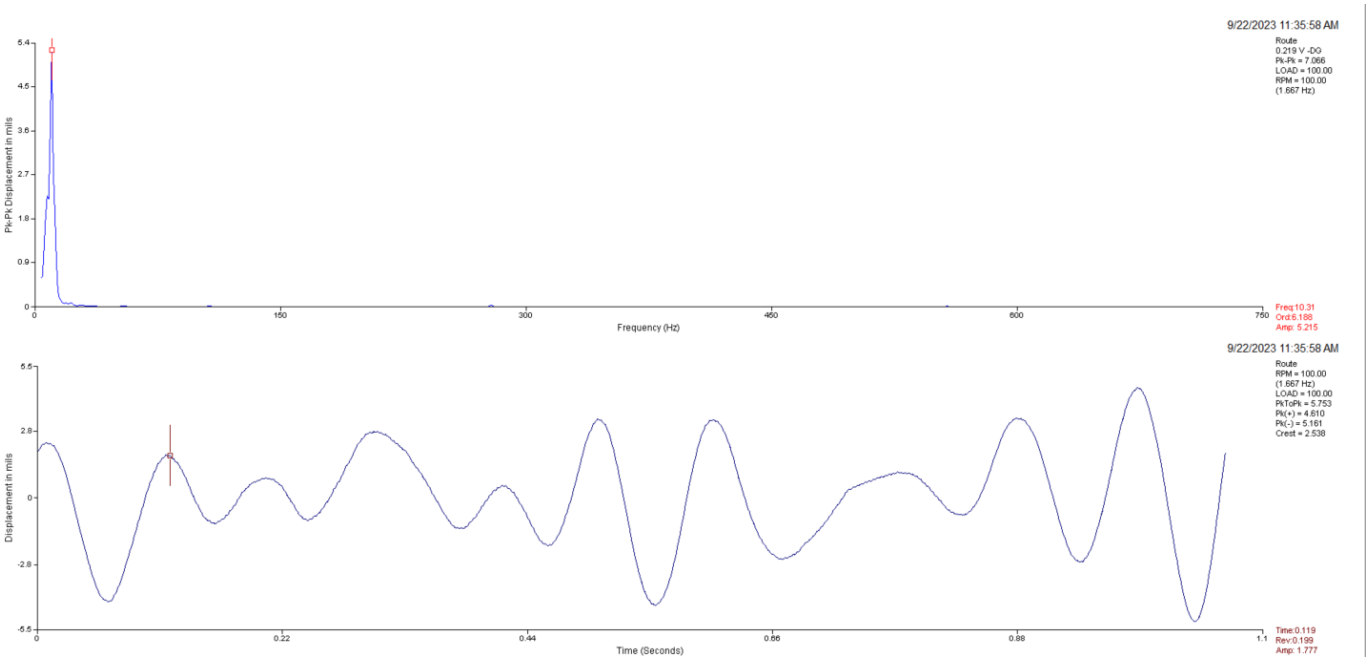
Observation:

Data above is a multipoint spectral waterfall. Data still shows some noise floor in the motor data. Data points labeled 11-23.

Recommendation:

Motor data still suggests a possible issue in the motor. May be rolling element defects in bearings. This issue appears to be minor at this time and we are monitoring this closely.

D Hydrogenator Agitator CLASS II



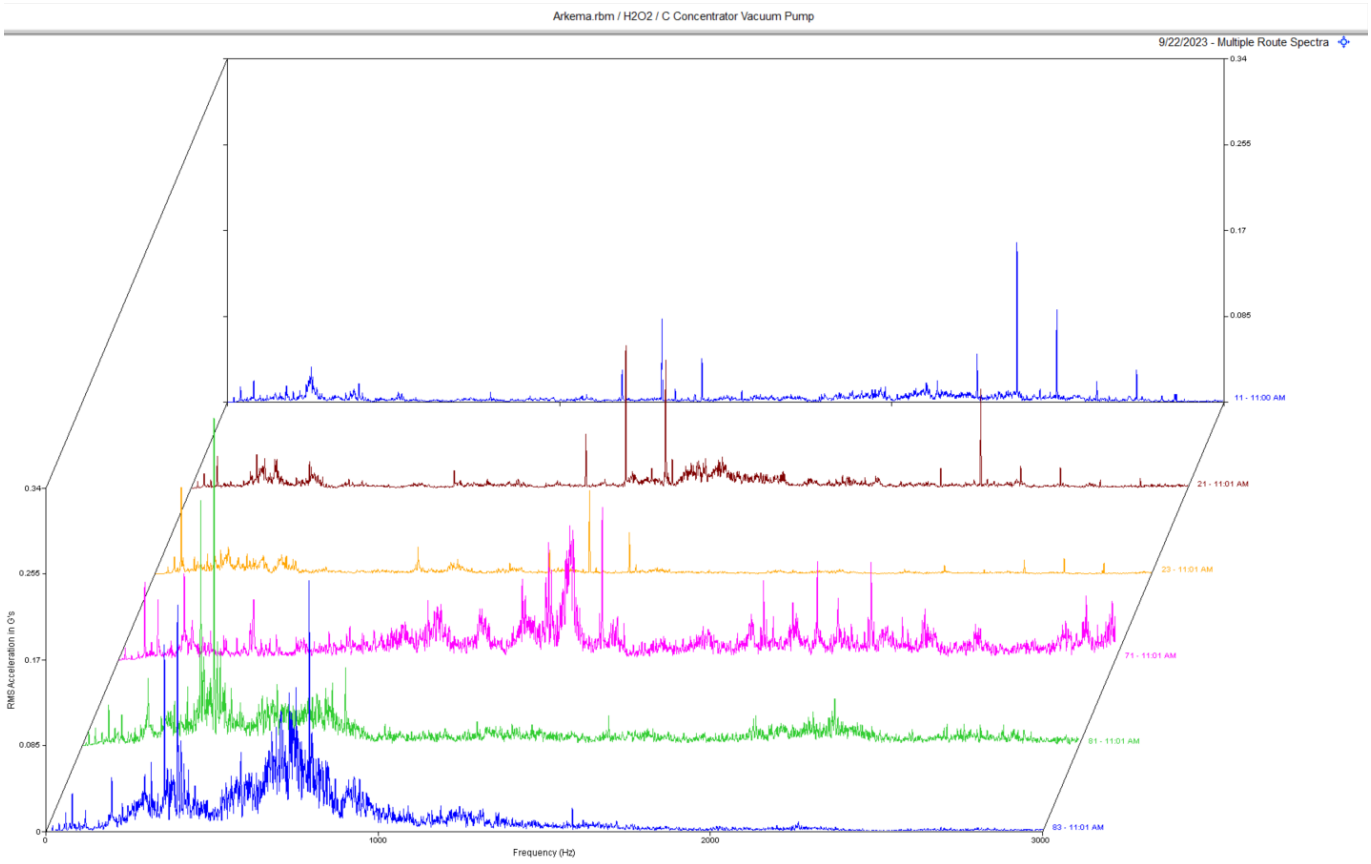
Observation:

Data above is output top radial direction (East-West). Displacement amplitudes are quite high. Waveform shows an amplitude of 10 mil peak-peak. There is quite a bit of low frequency vibration in the gear drive. Spectral and waveform data shows a dominant low frequency vibration that is likely a harmonic of output speed of the gearbox. Gearbox does appear to have visible torsional movement. The gear mesh vibration previously seen in the data appears to be lower this survey.

Recommendation:

Ensure output shaft does not excessive shaft defection. Check coupling hubs and shaft for run out using a dial indicator. Will continue to monitor closely.

C Concentrator Vacuum Pump CLASS I



Observation:

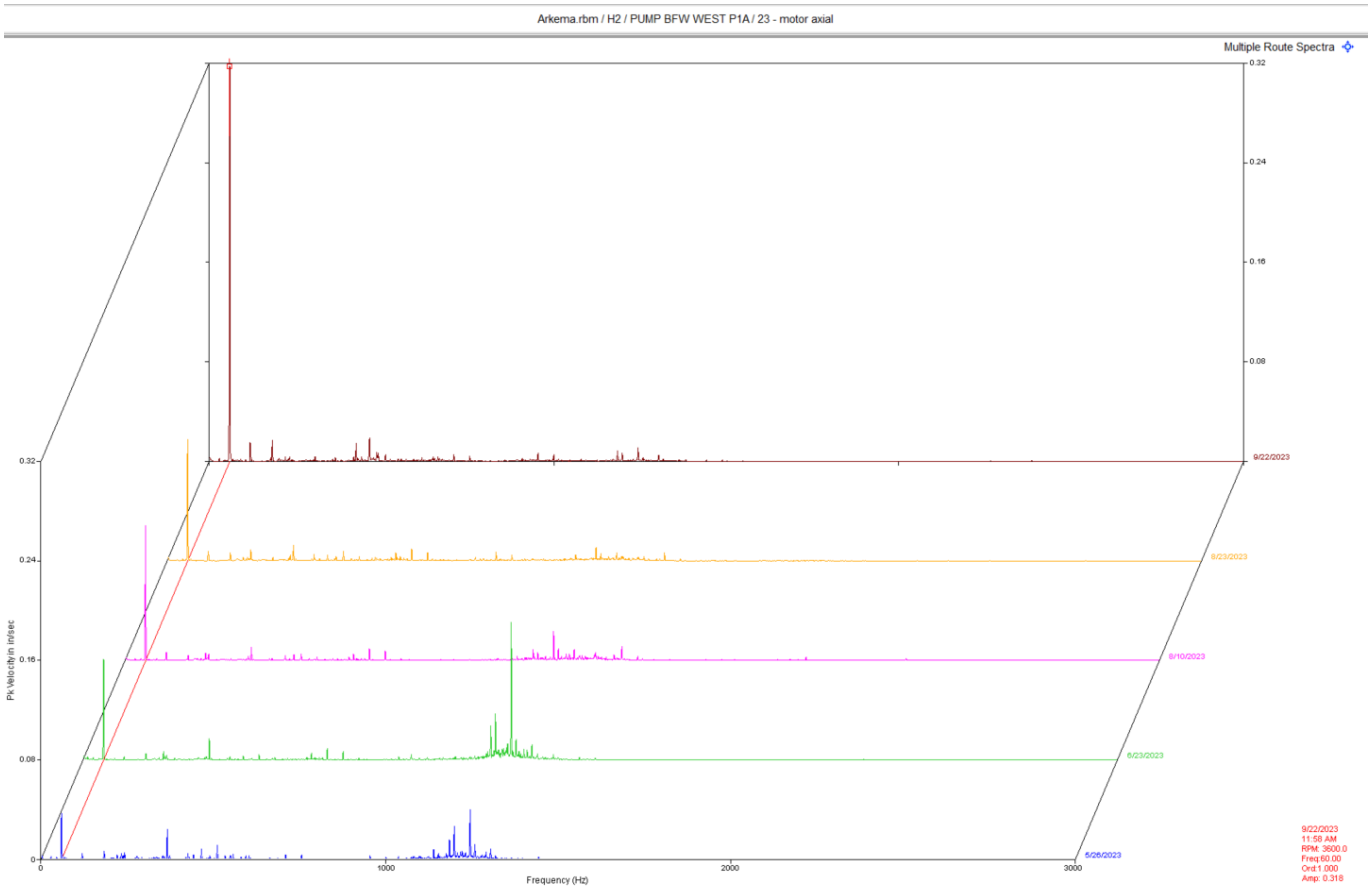
Data above is a multipoint spectral waterfall. Data point labeled 71 is the pump drive end horizontal. The small peaks in mid to high range of the spectrum appear to be non-synchronous peaks and are likely bearing defect frequencies.

Recommendation:

The pump appears to have possible early stage bearing defects/wear. We are monitoring this issue closely.

H2O2 Plant MONTHLY

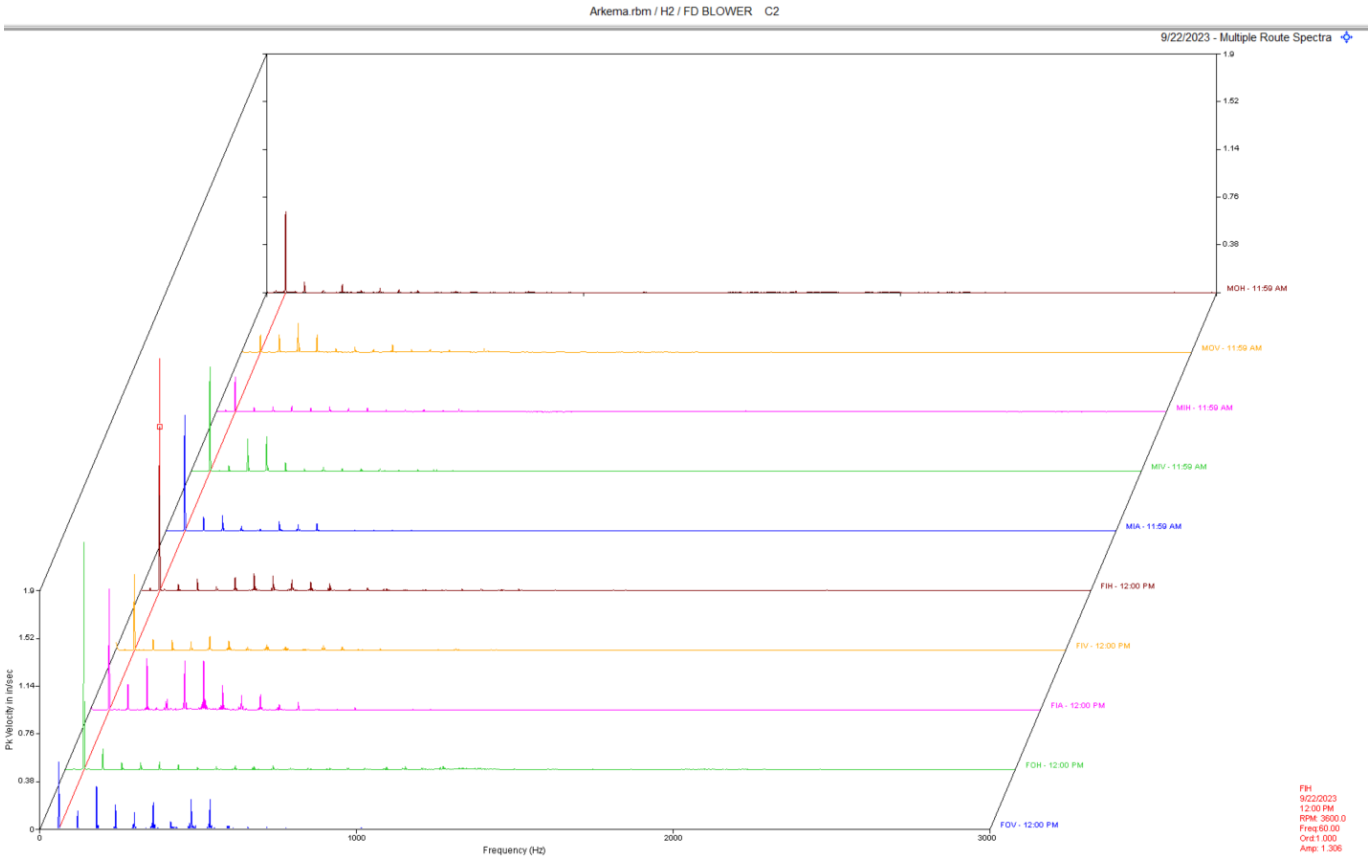
BFW Pump P1A CLASS II



Observation:
Data above is waterfall spectra of the motor axial. The large peak is 1 x rpm and waterfall data shows an increase at this peak.

Recommendation:
Inspect couplings and alignment as time allows.

FD Blower CLASS IV



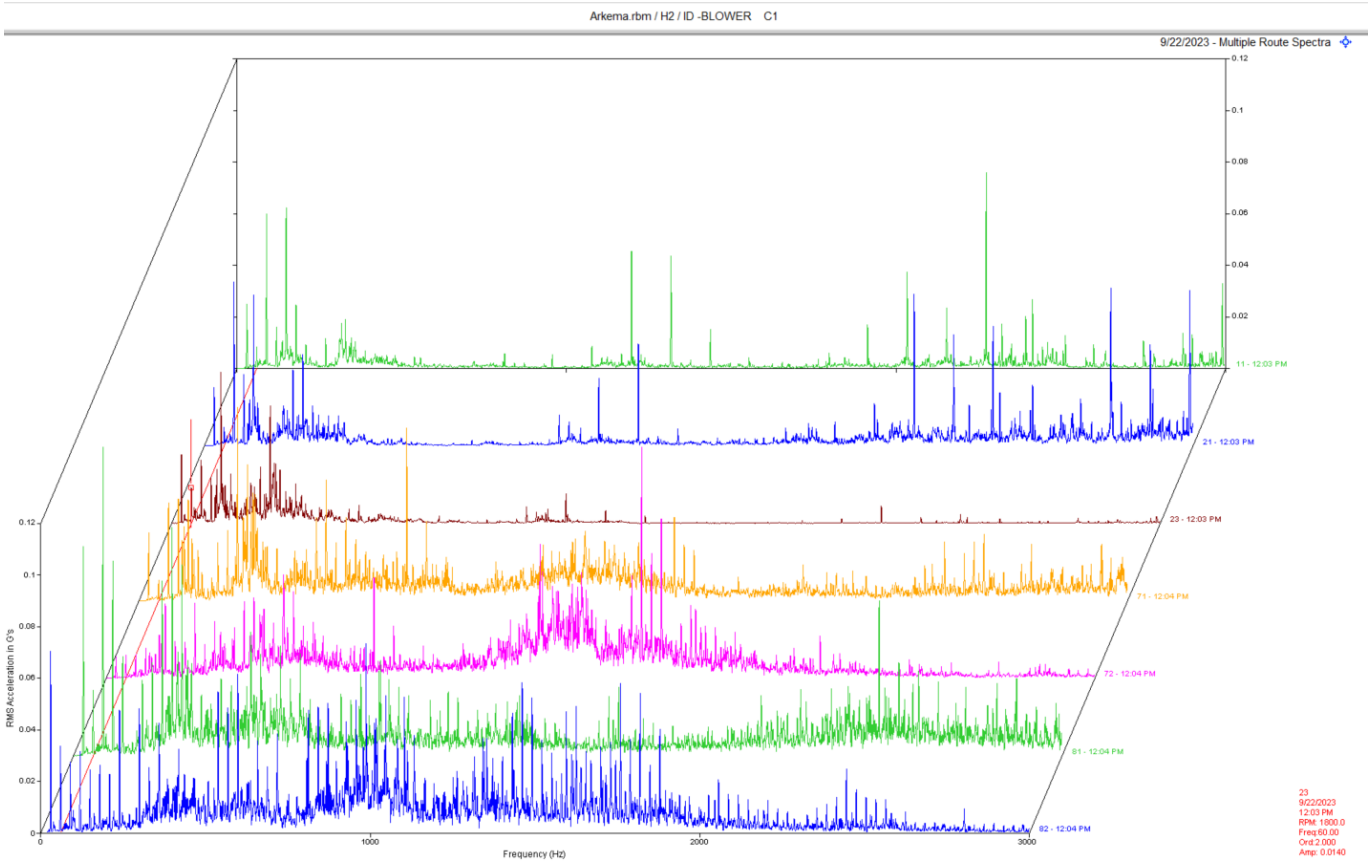
Observation:

Data above is multi-point waterfall of motor and fan. Data shows a high 1 x rpm with a smaller 2, 3, and 4 x rpm vibration. Vibration has increased significantly since replacing fan shaft and fan bearings. The shaft that in place right now has excessive run-out (.003 to .005" in various spots on shaft).

Recommendation:

Fan shaft and or the fan wheel is likely the issue here. We recommend replacing the fan shaft with a TGP 4140 (steel type) shaft. Replace bearings also. Ensure fan wheel is not warped or cracked. Fan wheel needs to be dynamically balanced with new shaft and coupling. **Replace ASAP due to high vibration.**

ID Blower CLASS II



Observation:

Data above is a multi-point spectrum of the motor and the fan Spectral data indicates bearing defects are present in the fan bearings.

Recommendation:

Not a lot of change since last survey. Fan bearings may need to be replaced in the next few months. Monitoring this issue closely.

Abbreviated Last Measurement Summary

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Database: Arkema.rbm
Station: PEROXIDE
Route No. 4: ARK WK4

MEASUREMENT POINT	OVERALL LEVEL	HFD / VHFD
P102 - ARKEMA PUMP P102	(22-Sep-23)	
	OVERALL LEVEL	1K-20KHz
MOH	.180 In/Sec	.474 G-s
MOV	.141 In/Sec	.420 G-s
MIH	.164 In/Sec	.889 G-s
MIV	.246 In/Sec	.581 G-s
MIA	.162 In/Sec	.410 G-s
EIA	.363 In/Sec	1.253 G-s
EIH	.240 In/Sec	1.861 G-s
EIV	.311 In/Sec	1.161 G-s
EOH	.274 In/Sec	.817 G-s
EOV	.235 In/Sec	2.884 G-s
XSTORPMP - X STORAGE PUMP	(22-Sep-23)	
	OVERALL LEVEL	1-20 KHz
11	.040 In/Sec	.535 G-s
21	.039 In/Sec	.384 G-s
23	.034 In/Sec	.222 G-s
71	.101 In/Sec	.171 G-s
72	.039 In/Sec	.156 G-s
YSTORPMP - Y STORAGE PUMP	(22-Sep-23)	
	OVERALL LEVEL	1-20 KHz
11	.210 In/Sec	.671 G-s
21	.210 In/Sec	.552 G-s
23	.056 In/Sec	.142 G-s
71	.204 In/Sec	.296 G-s
72	.050 In/Sec	.192 G-s
2130-1old - C Concentrator Vacuum Pump	(22-Sep-23)	
	OVERALL LEVEL	1-20 KHz
11	.072 In/Sec	.392 G-s
21	.086 In/Sec	.545 G-s
23	.135 In/Sec	.209 G-s
71	.164 In/Sec	2.469 G-s
81	.208 In/Sec	.618 G-s
83	.195 In/Sec	.307 G-s
7000-01 - AGITATOR,HYDROGENATOR C	(22-Sep-23)	
	OVERALL LEVEL	1-20 KHZ
02	.051 In/Sec	.0039 G-s
03	.039 In/Sec	.0038 G-s
11	.077 In/Sec	1.861 G-s
12	.111 In/Sec	.446 G-s
13	.109 In/Sec	.581 G-s
21	.092 In/Sec	1.107 G-s
22	.169 In/Sec	.270 G-s
23	.099 In/Sec	.224 G-s
31	.084 In/Sec	.449 G-s
32	.101 In/Sec	.109 G-s
33	.066 In/Sec	.082 G-s
41	.070 In/Sec	.194 G-s
42	.084 In/Sec	.264 G-s
51	.060 In/Sec	.201 G-s
53	.073 In/Sec	.071 G-s
61	.032 In/Sec	.214 G-s
71	.064 In/Sec	.171 G-s
81	.025 In/Sec	.249 G-s
83	.041 In/Sec	.187 G-s

57	- A/B Concentr Vac Pmp-var RPM	(22-Sep-23)	
		OVERALL LEVEL	1-20 KHz
	11	.033 In/Sec	.445 G-s
	12	.033 In/Sec	.117 G-s
	21	.039 In/Sec	.237 G-s
	23	.035 In/Sec	.094 G-s
	71	.059 In/Sec	.392 G-s
	81	.051 In/Sec	.418 G-s
	83	.050 In/Sec	.197 G-s
2130-1	- FLASH VAP VAC PUMP-var speed	(22-Sep-23)	
		OVERALL LEVEL	1-20 KHz
	11	.045 In/Sec	.338 G-s
	12	.041 In/Sec	.111 G-s
	21	.041 In/Sec	.562 G-s
	22	.042 In/Sec	.112 G-s
	23	.043 In/Sec	.082 G-s
	71	.073 In/Sec	.652 G-s
	72	.076 In/Sec	.590 G-s
	81	.077 In/Sec	1.220 G-s
	82	.080 In/Sec	.464 G-s
	83	.052 In/Sec	.399 G-s
C-203	- C-203 Comp	(22-Sep-23)	
		OVERALL LEVEL	1-20 KHz
	11	.060 In/Sec	2.522 G-s
	12	.029 In/Sec	.887 G-s
	21	.060 In/Sec	2.472 G-s
	22	.040 In/Sec	1.366 G-s
	23	.021 In/Sec	.464 G-s
		OVERALL LEVEL	1-20 KHZ
	71M	.050 In/Sec	3.630 G-s
	72M	.048 In/Sec	.828 G-s
	73M	.077 In/Sec	1.038 G-s
	81M	.050 In/Sec	4.836 G-s
	82M	.032 In/Sec	.838 G-s
	71F	.048 In/Sec	1.962 G-s
	72F	.057 In/Sec	.578 G-s
	73F	.020 In/Sec	.529 G-s
	81F	.048 In/Sec	5.663 G-s
	82F	.033 In/Sec	1.681 G-s
C-202	- C-202 Comp	(22-Sep-23)	
		OVERALL LEVEL	1-20 KHz
	11	.110 In/Sec	4.796 G-s
	12	.149 In/Sec	1.107 G-s
	21	.074 In/Sec	.986 G-s
	22	.066 In/Sec	.320 G-s
	23	.049 In/Sec	.182 G-s
		OVERALL LEVEL	1-20 KHZ
	71M	.057 In/Sec	3.090 G-s
	72M	.040 In/Sec	.768 G-s
	73M	.079 In/Sec	.836 G-s
	81M	.048 In/Sec	12.17 G-s
	82M	.035 In/Sec	1.188 G-s
	71F	.034 In/Sec	7.897 G-s
	72F	.068 In/Sec	.996 G-s
	73F	.050 In/Sec	1.444 G-s
	81F	.038 In/Sec	6.672 G-s
	82F	.044 In/Sec	.812 G-s
C-201	- C-201 Comp	(22-Sep-23)	
		OVERALL LEVEL	1-20 KHz
	11	.117 In/Sec	3.399 G-s
	12	.063 In/Sec	1.657 G-s
	21	.111 In/Sec	1.102 G-s
	22	.032 In/Sec	.308 G-s
	23	.065 In/Sec	.201 G-s
		OVERALL LEVEL	1-20 KHZ
	71M	.047 In/Sec	3.640 G-s

	72M	.032 In/Sec	.541 G-s
	73M	.062 In/Sec	.817 G-s
	81M	.036 In/Sec	9.972 G-s
	82M	.026 In/Sec	1.194 G-s
	71F	.035 In/Sec	2.375 G-s
	72F	.053 In/Sec	1.230 G-s
	73F	.037 In/Sec	1.012 G-s
	81F	.048 In/Sec	26.12 G-s
	82F	.056 In/Sec	1.175 G-s

new AC - INSTRUMENT AIR COMPRESSOR (22-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.092 In/Sec	1.212 G-s
12	.099 In/Sec	.509 G-s
13	.060 In/Sec	.297 G-s
21	.083 In/Sec	1.654 G-s
22	.078 In/Sec	.524 G-s
23	.034 In/Sec	.311 G-s
	OVERALL LEVEL	1-20 KHZ
71M	.138 In/Sec	8.656 G-s
72M	.101 In/Sec	2.826 G-s
73M	.150 In/Sec	1.539 G-s
81M	.202 In/Sec	4.014 G-s
82M	.231 In/Sec	1.693 G-s
83M	.263 In/Sec	1.645 G-s
71F	.167 In/Sec	13.73 G-s
72F	.089 In/Sec	2.984 G-s
73F	.118 In/Sec	1.713 G-s
81F	.163 In/Sec	4.190 G-s
82F	.158 In/Sec	1.663 G-s
83F	.134 In/Sec	1.909 G-s

201-08A - COMPRESSOR,NASH A 201-08A (22-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.051 In/Sec	.156 G-s
12	.056 In/Sec	.092 G-s
13	.118 In/Sec	.091 G-s
21	.058 In/Sec	.199 G-s
22	.061 In/Sec	.095 G-s
23	.168 In/Sec	.107 G-s
71	.175 In/Sec	.674 G-s
72	.191 In/Sec	.214 G-s
73	.144 In/Sec	.216 G-s
81	.161 In/Sec	.238 G-s
82	.184 In/Sec	.095 G-s
83	.123 In/Sec	.185 G-s

202-05 - NASH SEAL LIQUID PUMP-A (22-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.021 In/Sec	.104 G-s
21	.020 In/Sec	.163 G-s
23	.025 In/Sec	.051 G-s
71	.037 In/Sec	.062 G-s
72	.020 In/Sec	.035 G-s

9002-10 - D-HYDROGENATOR AGITATOR (22-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.072 In/Sec	.177 G-s
21	.071 In/Sec	.257 G-s
23	.082 In/Sec	.070 G-s
	OVERALL LEVEL	1-20 KHZ
31	.189 In/Sec	.652 G-s
31L	.133 In/Sec	.670 G-s
	OVERALL LEVEL	1-20 KHz
51	.274 In/Sec	.248 G-s
51L	.274 In/Sec	.248 G-s
52	.060 In/Sec	.342 G-s
52L	.219 In/Sec	.430 G-s
53	.222 In/Sec	.299 G-s
53L	.264 In/Sec	.337 G-s

	61	.155 In/Sec	.172 G-s
	61L	.172 In/Sec	.172 G-s
	81	.049 In/Sec	.048 G-s
	82	.028 In/Sec	.025 G-s
	83	.037 In/Sec	.0072 G-s

Database: Arkema.rbm
Station: HYDROGEN
Route No. 1: H2 MONTHLY

MEASUREMENT POINT		OVERALL LEVEL	HFD / VHFD
P2A	- PUMP MEA CIRC WEST P2A	(22-Sep-23)	
		OVERALL LEVEL	1-20 KHz
	11	.055 In/Sec	.318 G-s
	21	.042 In/Sec	.742 G-s
	23	.043 In/Sec	.416 G-s
	71	.176 In/Sec	1.080 G-s
	72	.217 In/Sec	.405 G-s
P1A	- PUMP BFW WEST P1A	(22-Sep-23)	
		OVERALL LEVEL	1-20 KHz
	11	.207 In/Sec	.797 G-s
	21	.209 In/Sec	1.348 G-s
	23	.352 In/Sec	.638 G-s
	71	.304 In/Sec	.904 G-s
	72	.146 In/Sec	.458 G-s
	81	.126 In/Sec	1.043 G-s
	82	.068 In/Sec	.473 G-s
	83	.109 In/Sec	.797 G-s
C2	- FD BLOWER C2	(22-Sep-23)	
		OVERALL LEVEL	1-20 KHz
	MOH	.710 In/Sec	1.161 G-s
	MOV	.371 In/Sec	.335 G-s
	MIH	.323 In/Sec	1.067 G-s
	MIV	.988 In/Sec	.346 G-s
	MIA	1.017 In/Sec	.265 G-s
	FIH	1.419 In/Sec	1.904 G-s
	FIV	.693 In/Sec	.968 G-s
	FIA	1.339 In/Sec	.573 G-s
	FOH	1.943 In/Sec	3.229 G-s
	FOV	.876 In/Sec	.932 G-s
C1	- ID -BLOWER C1	(22-Sep-23)	
		OVERALL LEVEL	1-20 KHz
	11	.111 In/Sec	.462 G-s
	21	.112 In/Sec	.401 G-s
	23	.107 In/Sec	.075 G-s
	71	.118 In/Sec	.924 G-s
	72	.059 In/Sec	.772 G-s
	81	.286 In/Sec	1.169 G-s
	82	.226 In/Sec	.551 G-s
CTPE	- EAST COOLING TOWER PUMP	(22-Sep-23)	
		OVERALL LEVEL	1-20 KHz
	11	.159 In/Sec	1.575 G-s
	21	.071 In/Sec	1.397 G-s
	23	.197 In/Sec	.446 G-s
	71	.245 In/Sec	1.801 G-s
	72	.253 In/Sec	.309 G-s
CTPC	- CENTER COOLING TOWER PUMP	(22-Sep-23)	
		OVERALL LEVEL	1-20 KHz
	11	.177 In/Sec	1.039 G-s
	21	.087 In/Sec	1.996 G-s

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            23                      .126 In/Sec       .521 G-s
            71                      .170 In/Sec      1.524 G-s
            72                      .284 In/Sec       .494 G-s

-------------------------------------------------------------------------------
   Clarification Of Vibration Units:
      Acc       -->  G-s       PK
      Vel       -->  In/Sec    PK
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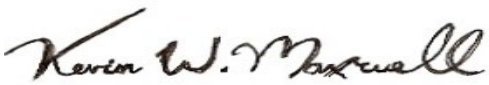
As always, it has been a pleasure to serve Arkema. If there are any comments or questions, do not hesitate to contact us.

Sincerely,



ISO Certified Vibration Analyst, Category III

HI-SPEED INDUSTRIAL SERVICE

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