HI-SPEED INDUSTRIAL SERVICE QualiTest® Diagnostics

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July 19, 2022

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The following is a summary of findings from the WEEK 3 vibration survey at the H2O2 Plant and the monthly H2 survey that was performed on July 15, 2022.

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.

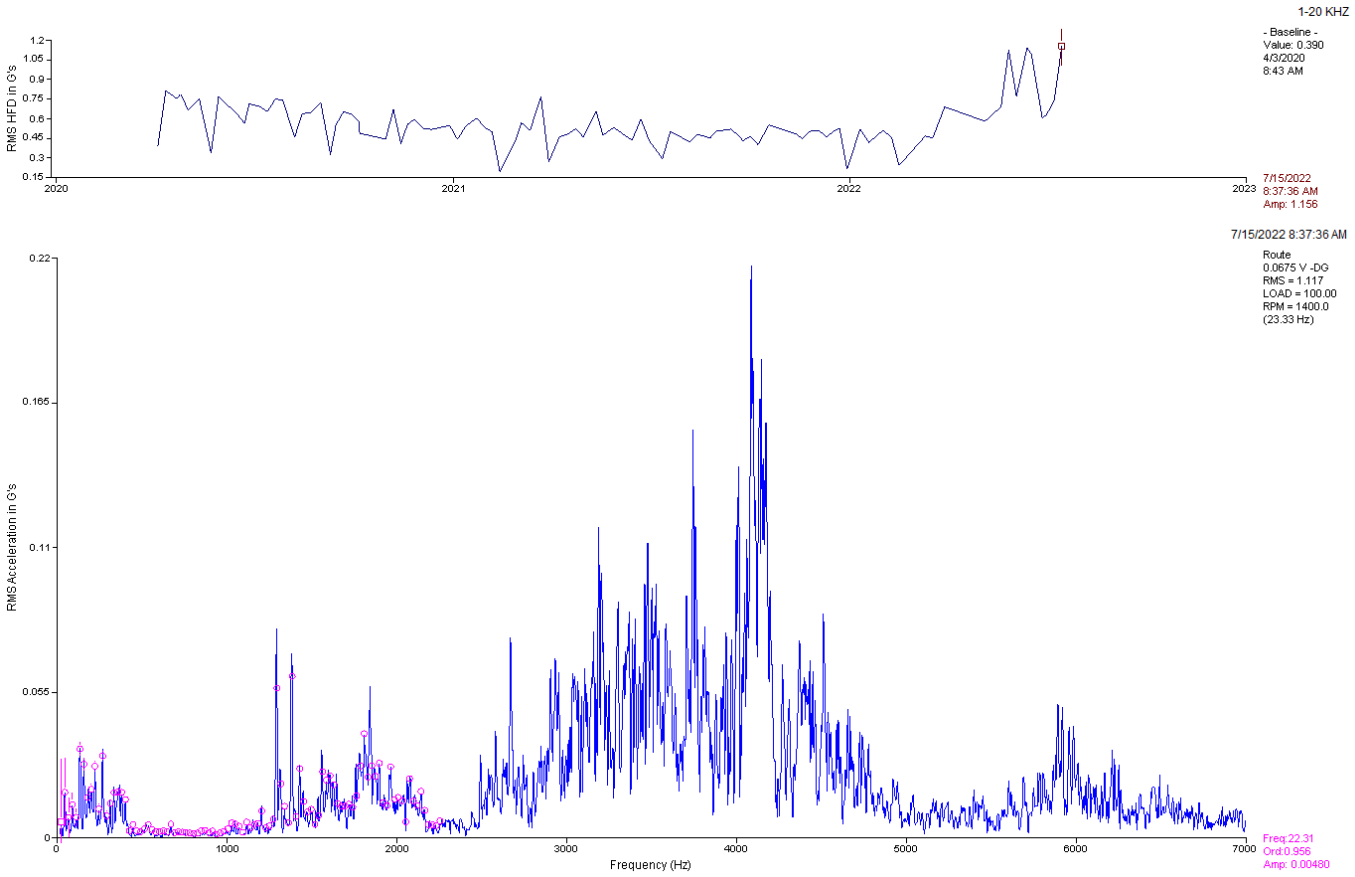
CLASS II: Defect (s) present that may cause problem in long term (2-6 months). Repair during normal maintenance scheduling. Continue to monitor.

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

C Hydrogenator Agitator CLASS I



Observation:

Data above is the motor outboard horizontal. Spectrum shows a lot of noise between 2500-5000 Hz.

Recommendation:

Data suggests possible lubrication issue. Motor bearings may also have some light defects. Ensure motor bearings have clean adequate amount of grease.

D Hydrogenator Agitator CLASS II

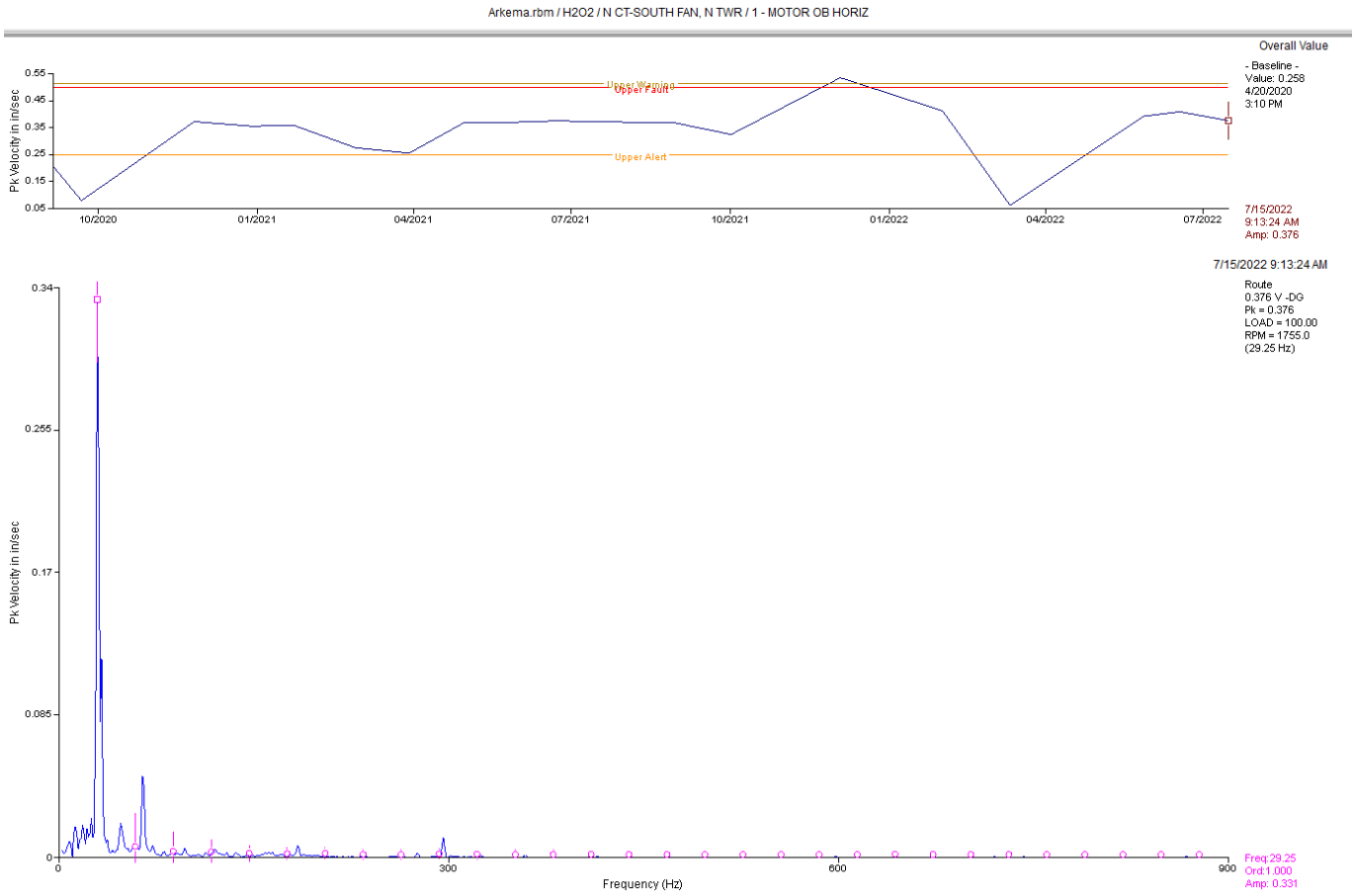
Observation:

Motor axial is higher than normal. Gearbox does have physical torsional type movement and may be causing some of the motor axial vibration. Data shown is output top end of gearbox N-S direction. Dominant vibration is around 10 Hz with modulation around this peak. Gearbox has some vibration at a sub harmonic of motor 1 x rpm which may indicate some int. shaft and or output shaft gear wear.

Recommendation:

Ensure motor/gearbox does not have misalignment. Inspect couplings and drive shaft for issues. Gearbox also seemed to have excessive movement while taking data. This is causing excessive axial movement of the jack shaft and is causing motor axial vibration. Inspect structure/gearbox mounts for signs of fatigue, cracks, etc. Output shaft may be bowed or bent.

N-CT SF North Cooling Tower South Fan CLASS II



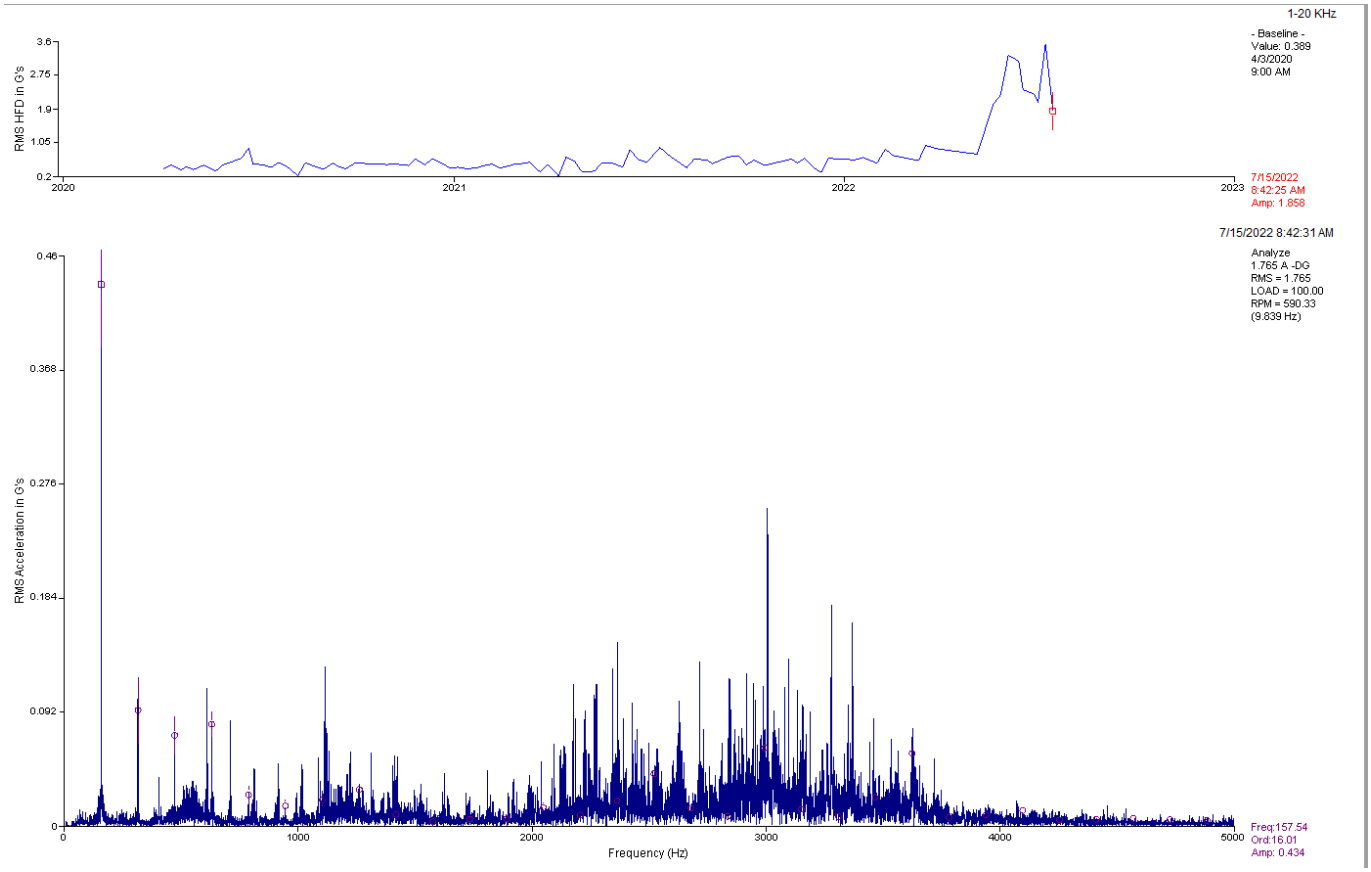
Observation:

MOH spectral waterfall shows some vibration at what appears to be close to 1 x motor rpm. Trend data shows this vibration to go up and down in amplitude.

Recommendation:

Inspect drive train components for wear. Ensure all fasteners are tight. It is also possible that this vibration is a resonant vibration.

A/B Concentrator Vacuum Pump CLASS II



Observation:

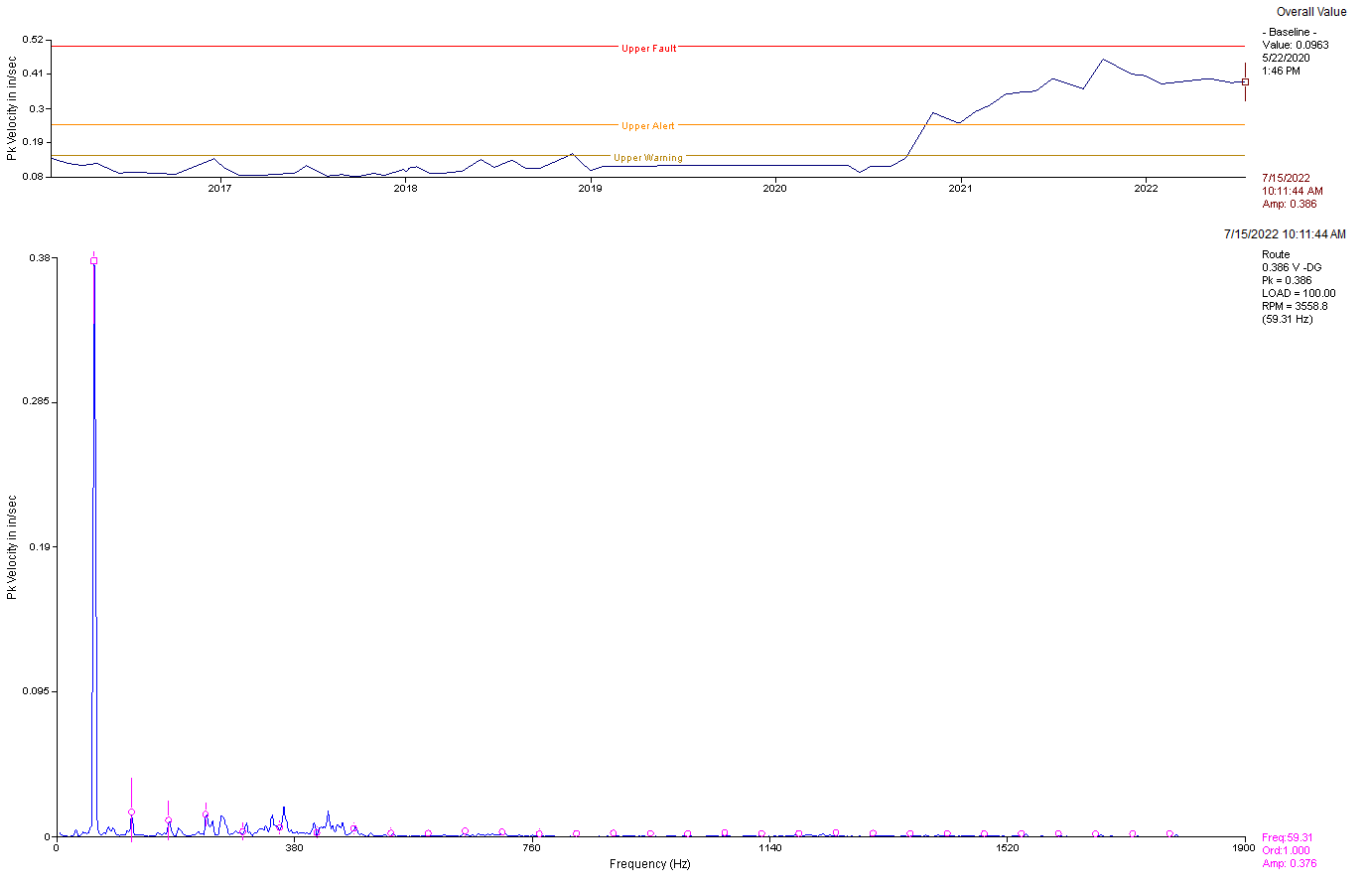
Data above is the outboard pump bearing horizontal. Peaks in spectrum are 16 x rpm and harmonics there of which are related to vane pass. There is also quite a bit of non-synchronous vibration as well. Trend data of POH shows decreased high frequency amplitude.

Recommendation:

Pump has elevated vane pass vibrations which is likely due to process flow issues and or internal pump issues. Pump bearings still appear to have defects according to the spectral data. Pump may need to be replaced in the upcoming months.

H2 Monthly

H2 FD Fan CLASS II



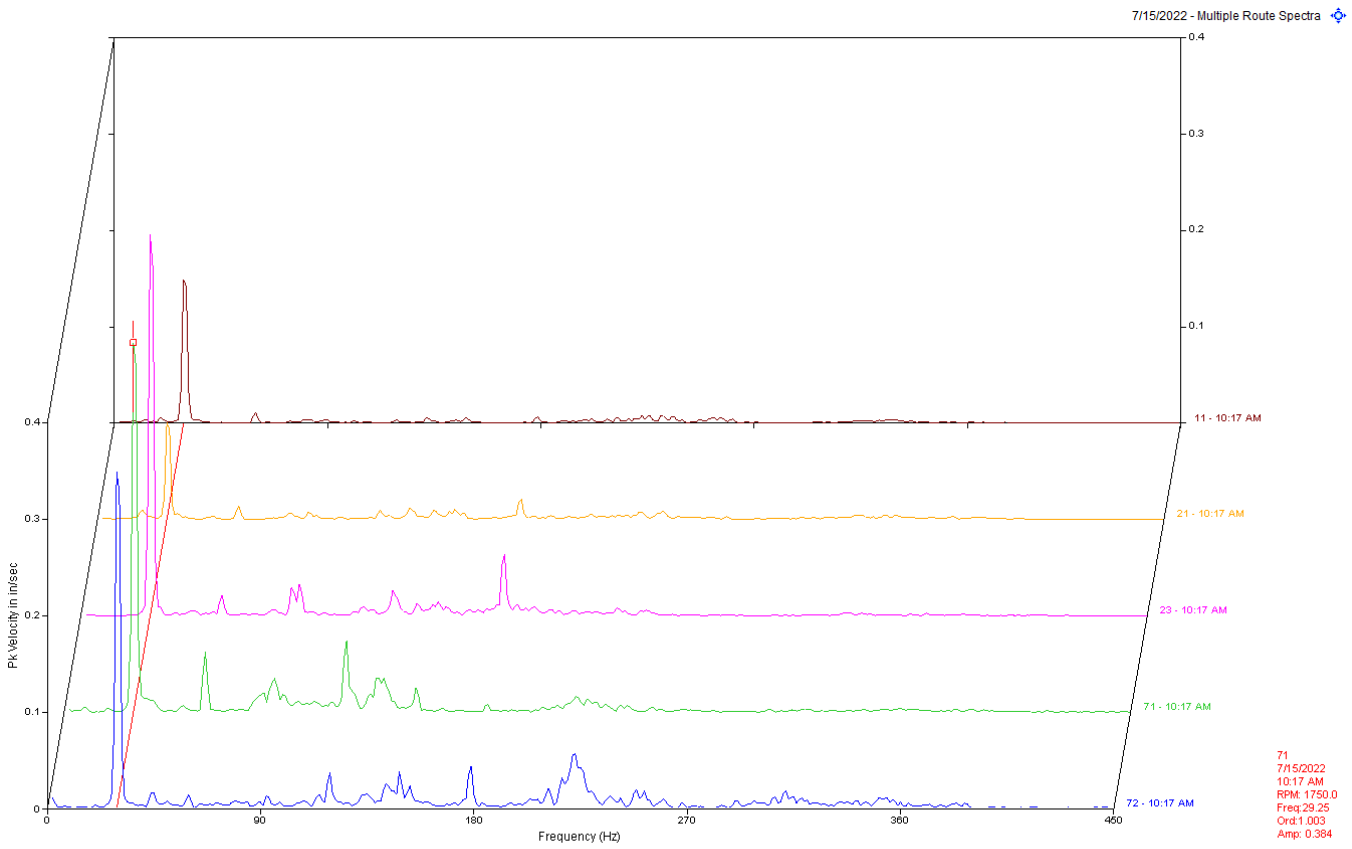
Observation:

Data above is the Motor OB Horz. Data shows a dominant 1 x rpm vibration. Trend data shows a steady increase in overall amplitude.

Recommendation:

Coupling may be the issue here. There is also some possibility of the fan bearings have some fit wear which could influence this some. For now, it is recommended to inspect the couplings for wear and ensure alignment is good and all fasteners are tight.

H2 Center Cooling Tower Pump CLASS II



Observation:

Data above is multi point spectra of the motor and pump. Data shows a high vibration at 1 x rpm.

Recommendation:

All three of these cooling tower motors/pumps have base issues. They were not installed correctly. Bases need to be leveled and fastened properly to the concrete. There should not be gaps between the base frame and the concrete pad. The bases also need to epoxy grouted. Because the bases are not installed correctly, there is excessive vibration, especially in the motor verticals. Ensure bases are leveled, fastened properly, and grouted in as soon as time allows.

Abbreviated Last Measurement Summary

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Database: Arkema.rbm
Station: PEROXIDE
Route No. 5: ARK WK 3

MEASUREMENT POINT	OVERALL LEVEL	HFD / VHFD
XSTORPMP - X STORAGE PUMP	(15-Jul-22)	
	OVERALL LEVEL	1-20 KHz
11 - MOTOR OUTBOARD HORIZONTAL	.071 In/Sec	.267 G-s
21 - MOTOR INBOARD HORIZONTAL	.082 In/Sec	.219 G-s
23 - MOTOR INBOARD AXIAL	.075 In/Sec	.224 G-s
71 - PUMP HORIZONTAL	.176 In/Sec	.159 G-s
72 - PUMP VERTICAL	.058 In/Sec	.176 G-s
YSTORPMP - Y STORAGE PUMP	(15-Jul-22)	
	OVERALL LEVEL	1-20 KHz
11 - MOTOR OUTBOARD HORIZONTAL	.011 In/Sec	.0016 G-s
21 - MOTOR INBOARD HORIZONTAL	.021 In/Sec	.0016 G-s
23 - MOTOR INBOARD AXIAL	.0050 In/Sec	.0015 G-s
2130-1old - C Concentrator Vacuum Pump	(15-Jul-22)	
	OVERALL LEVEL	1-20 KHz
11 - Motor OB HOR	.069 In/Sec	.455 G-s
21 - Motor IB HOR	.072 In/Sec	.682 G-s
23 - Motor IB AXIAL	.174 In/Sec	.153 G-s
71 - Compressor IB HOR	.099 In/Sec	1.124 G-s
81 - Compressor OB Horiz	.125 In/Sec	.520 G-s
83 - Compressor OB Axial	.086 In/Sec	1.670 G-s
7000-01 - AGITATOR,HYDROGENATOR C	(15-Jul-22)	
	OVERALL LEVEL	1-20 KHZ
11 - C Hydro Agitator MOTOR OB HORIZ	.068 In/Sec	1.634 G-s
12 - C Hydro Agitator MOTOR OB VERT	.077 In/Sec	1.166 G-s
13 - C Hydro Agitator Motor OB Axial	.061 In/Sec	1.259 G-s
21 - C Hydro Agitator MOTOR IB HORIZ	.080 In/Sec	1.075 G-s
22 - C Hydro Agitator MOTOR IB VERT	.151 In/Sec	1.373 G-s
23 - C Hydro Agitator Motor IB Axial	.088 In/Sec	1.416 G-s
31 - C Hydro Agitator GrBx In Horizon	.072 In/Sec	.410 G-s
32 - C Hydro Agitator GrBx In VERT	.072 In/Sec	.464 G-s
33 - C Hydro Agitator GrBx In Axial	.042 In/Sec	.299 G-s
41 - C HY AG GBX INPUT OUTBOARD HZ	.068 In/Sec	.295 G-s
42 - C HY AG GBX INPUT OUTBOARD VERT	.078 In/Sec	.684 G-s
51 - C Hydro GrBx shaft 2 Top HZ E-W	.056 In/Sec	.195 G-s
53 - C Hydro GrBx shaft 2 Top AXIAL	.097 In/Sec	.267 G-s
61 - C Hydro GrBx shaft 2 BOT HZ E-W	.029 In/Sec	.291 G-s
71 - C Hydro GrBx OUTPUT TOP HZ E-W	.047 In/Sec	.283 G-s
81 - C Hydro GrBx OUTPUT BOT HZ E-W	.026 In/Sec	.224 G-s
83 - C Hydro GrBx OUTPUT Top Axial	.054 In/Sec	.314 G-s
57 - A/B Concentr Vac Pmp-var RPM	(15-Jul-22)	
	OVERALL LEVEL	1-20 KHz
11 - Motor OB HOR	.056 In/Sec	.455 G-s
12 - Motor OB VERT	.052 In/Sec	.382 G-s
21 - Motor IB HOR	.060 In/Sec	.451 G-s
23 - Motor IB AXIAL	.049 In/Sec	.292 G-s
71 - Compressor IB HOR	.111 In/Sec	.382 G-s
81 - Compressor OB Horiz	.359 In/Sec	2.627 G-s
83 - Compressor OB Axial	.101 In/Sec	2.282 G-s
2130-1 - FLASH VAP VAC PUMP-var speed	(15-Jul-22)	
	OVERALL LEVEL	1-20 KHz
11 - Motor OB HOR	.049 In/Sec	.550 G-s
12 - Motor OB VERT	.035 In/Sec	.490 G-s

21 - Motor IB HOR	.043 In/Sec	.605 G-s
22 - Motor IB VERT	.047 In/Sec	.606 G-s
23 - Motor IB AXIAL	.051 In/Sec	.555 G-s
71 - Compressor IB HOR	.061 In/Sec	.464 G-s
72 - Compressor IB VERT	.056 In/Sec	.383 G-s
81 - Compressor OB Horiz	.072 In/Sec	1.065 G-s
82 - Compressor OB VERT	.073 In/Sec	1.379 G-s
83 - Compressor OB Axial	.041 In/Sec	1.050 G-s

C-203	- C-203 Comp	(15-Jul-22)	
		OVERALL LEVEL	1-20 KHz
11 - MOTOR OB HOR		.034 In/Sec	.822 G-s
12 - MOTOR OB VERT		.034 In/Sec	.940 G-s
21 - MOTOR IB HOR		.044 In/Sec	1.735 G-s
22 - MOTOR IB VERT		.019 In/Sec	.307 G-s
23 - MOTOR IB AXIAL		.042 In/Sec	1.643 G-s
		OVERALL LEVEL	1-20 KHZ
71M - COMP MALE SHAFT IB HOR		.058 In/Sec	3.365 G-s
72M - COMP MALE SHAFT IB VERT		.044 In/Sec	3.472 G-s
73M - COMP MALE SHAFT IB AXIAL		.043 In/Sec	2.342 G-s
81M - COMP MALE SHAFT OB HOR		.036 In/Sec	4.605 G-s
82M - COMP MALE SHAFT OB VERT		.060 In/Sec	2.236 G-s
71F - COMP FEMALE SHAFT IB HOR		.033 In/Sec	2.269 G-s
72F - COMP FEMALE SHAFT IB VERT		.050 In/Sec	1.630 G-s
73F - COMP FEMALE SHAFT IB AXIAL		.114 In/Sec	2.749 G-s
81F - COMP FEMALE SHAFT OB HOR		.029 In/Sec	2.286 G-s
82F - COMP FEMALE SHAFT OB VERT		.034 In/Sec	1.473 G-s

C-202	- C-202 Comp	(15-Jul-22)	
		OVERALL LEVEL	1-20 KHz
11 - MOTOR OB HOR		.085 In/Sec	2.917 G-s
12 - MOTOR OB VERT		.109 In/Sec	.527 G-s
21 - MOTOR IB HOR		.063 In/Sec	.407 G-s
22 - MOTOR IB VERT		.061 In/Sec	.154 G-s
23 - MOTOR IB AXIAL		.066 In/Sec	1.502 G-s
		OVERALL LEVEL	1-20 KHZ
71M - COMP MALE SHAFT IB HOR		.038 In/Sec	2.881 G-s
72M - COMP MALE SHAFT IB VERT		.051 In/Sec	2.534 G-s
73M - COMP MALE SHAFT IB AXIAL		.063 In/Sec	3.151 G-s
81M - COMP MALE SHAFT OB HOR		.039 In/Sec	7.747 G-s
82M - COMP MALE SHAFT OB VERT		.061 In/Sec	2.797 G-s
71F - COMP FEMALE SHAFT IB HOR		.027 In/Sec	1.992 G-s
72F - COMP FEMALE SHAFT IB VERT		.062 In/Sec	4.320 G-s
73F - COMP FEMALE SHAFT IB AXIAL		.073 In/Sec	3.847 G-s
81F - COMP FEMALE SHAFT OB HOR		.028 In/Sec	3.072 G-s
82F - COMP FEMALE SHAFT OB VERT		.048 In/Sec	6.318 G-s

C-201	- C-201 Comp	(15-Jul-22)	
		OVERALL LEVEL	1-20 KHz
11 - MOTOR OB HOR		.092 In/Sec	1.103 G-s
12 - MOTOR OB VERT		.087 In/Sec	1.717 G-s
21 - MOTOR IB HOR		.098 In/Sec	1.515 G-s
22 - MOTOR IB VERT		.036 In/Sec	.221 G-s
23 - MOTOR IB AXIAL		.080 In/Sec	1.953 G-s
		OVERALL LEVEL	1-20 KHZ
71M - COMP MALE SHAFT IB HOR		.048 In/Sec	3.398 G-s
72M - COMP MALE SHAFT IB VERT		.049 In/Sec	2.886 G-s
73M - COMP MALE SHAFT IB AXIAL		.065 In/Sec	3.110 G-s
81M - COMP MALE SHAFT OB HOR		.041 In/Sec	11.27 G-s
82M - COMP MALE SHAFT OB VERT		.055 In/Sec	2.541 G-s
71F - COMP FEMALE SHAFT IB HOR		.036 In/Sec	3.919 G-s
72F - COMP FEMALE SHAFT IB VERT		.050 In/Sec	3.709 G-s
73F - COMP FEMALE SHAFT IB AXIAL		.088 In/Sec	3.581 G-s
81F - COMP FEMALE SHAFT OB HOR		.032 In/Sec	3.715 G-s
82F - COMP FEMALE SHAFT OB VERT		.049 In/Sec	3.033 G-s

new AC	- INSTRUMENT AIR COMPRESSOR	(15-Jul-22)	
		OVERALL LEVEL	1-20 KHz
11 - MOTOR OB HOR		.109 In/Sec	1.026 G-s
12 - MOTOR OB VERT		.100 In/Sec	1.214 G-s

13 - MOTOR OB AXIAL	.060 In/Sec	.698 G-s
21 - MOTOR IB HOR	.087 In/Sec	1.223 G-s
22 - MOTOR IB VERT	.090 In/Sec	1.524 G-s
23 - MOTOR IB AXIAL	.046 In/Sec	.906 G-s
	OVERALL LEVEL	1-20 KHZ
71F - COMP FEMALE SHAFT IB HOR	.146 In/Sec	6.144 G-s
72F - COMP FEMALE SHAFT IB VERT	.144 In/Sec	4.187 G-s
73F - COMP FEMALE SHAFT IB AXIAL	.167 In/Sec	4.151 G-s
81F - COMP FEMALE SHAFT OB HOR	.116 In/Sec	2.698 G-s
82F - COMP FEMALE SHAFT OB VERT	.204 In/Sec	3.809 G-s
83F - COMP FEMALE SHAFT OB AXIAL	.216 In/Sec	5.784 G-s
71M - COMP MALE SHAFT IB HOR	.131 In/Sec	6.776 G-s
72M - COMP MALE SHAFT IB VERT	.176 In/Sec	6.207 G-s
73M - COMP MALE SHAFT IB AXIAL	.105 In/Sec	6.921 G-s
81M - COMP MALE SHAFT OB HOR	.140 In/Sec	3.600 G-s
82M - COMP MALE SHAFT OB VERT	.311 In/Sec	2.474 G-s
83M - COMP MALE SHAFT OB AXIAL	.248 In/Sec	5.919 G-s

201-08A - COMPRESSOR,NASH A 201-08A	(15-Jul-22)	
	OVERALL LEVEL	1-20 KHz
11 - Nash Compr A Motor OB Horiz	.054 In/Sec	.193 G-s
12 - Nash Compr A Motor OB Vertical	.060 In/Sec	.174 G-s
13 - Nash Compr A Motor OB Axial	.142 In/Sec	.205 G-s
21 - Nash Compr A Motor IB Horiz	.055 In/Sec	.077 G-s
22 - Nash Compr A Motor IB VERT	.060 In/Sec	.098 G-s
23 - Nash Compr A Motor IB AXIAL	.119 In/Sec	.091 G-s
71 - Nash Compr A COMP IB HORIZ	.149 In/Sec	.413 G-s
72 - Nash Compr A Compressor IB Verti	.152 In/Sec	.335 G-s
73 - Nash Compr A COMP IB AXIAL	.122 In/Sec	.213 G-s
81 - Nash Compr A COMP OB HORIZ	.134 In/Sec	.161 G-s
82 - Nash Compr A Compressor OB Verti	.177 In/Sec	.161 G-s
83 - Nash Compr A Compressor OB Axial	.129 In/Sec	.229 G-s

9002-10 - D-HYDROGENATOR AGITATOR	(15-Jul-22)	
	OVERALL LEVEL	1-20 KHz
11 - MOTOR OUTBOARD HORIZONTAL	.101 In/Sec	.355 G-s
21 - MOTOR INBOARD HORIZONTAL	.065 In/Sec	.161 G-s
23 - MOTOR INBOARD AXIAL	.193 In/Sec	.156 G-s
	OVERALL LEVEL	1-20 KHZ
31 - GEARBOX INPUT SHAFT -HORIZONTAL	.170 In/Sec	.666 G-s
31L - GEARBOX INPUT SHAFT-N-S-LOW FRQ	.164 In/Sec	.465 G-s
	OVERALL LEVEL	1-20 KHz
51 - GEARBOX OUTPUT TOP E-W	.259 In/Sec	.267 G-s
51L - GEARBOX OUTPUT TOP E-W- 100RPM	.210 In/Sec	.246 G-s
52 - GEARBOX TOP PLATE- N-S	.270 In/Sec	.155 G-s
52L - GEARBOX OUTPUT TOP N-S 100RPM	.211 In/Sec	.152 G-s
53 - GEARBOX OUTPUT TOP -AXIAL	.060 In/Sec	.355 G-s
53L - GEARBOX OUTPUT TOP AXIAL 100RPM	.025 In/Sec	.258 G-s
61 - GEARBOX OUTPUT BOTTOM E-W-HZ	.200 In/Sec	.384 G-s
61L - GEARBOX OUTPUT BOTTOM-E-W 100RPM	.180 In/Sec	.425 G-s
81 - AGIT INTERMED BRG @ SEAL- N-S	.208 In/Sec	.161 G-s
82 - AGIT INTERMED BRG @ SEAL- E-W	.270 In/Sec	.220 G-s
83 - AGIT INTERMED BRG @ SEAL- VERT	.045 In/Sec	.233 G-s

NTC-SF - N CT-SOUTH FAN, N TWR	(15-Jul-22)	
	OVERALL LEVEL	1-20 KHz
1 - MOTOR OB HORIZ	.376 In/Sec	.536 G-s
2 - MOTOR IB HORIZ	.193 In/Sec	.396 G-s
3 - MOTOR IB AXIAL	.201 In/Sec	.471 G-s
	OVERALL LEVEL	1-20 KHZ
4 - GEARBOX INPUT HORIZONTAL	.210 In/Sec	.410 G-s
5 - GEARBOX VERTICAL	.0067 In/Sec	.0011 G-s
6 - GEARBOX AXIAL	.308 In/Sec	.400 G-s
6L - GEARBOX AXIAL LOW FREQ	.276 In/Sec	.359 G-s

NCT - NF - N CT -NORTH FAN, N TWR	(15-Jul-22)	
	OVERALL LEVEL	1-20 KHz
7 - MOTOR OB HORIZ	.244 In/Sec	.475 G-s
8 - MOTOR IB HORIZ	.149 In/Sec	.424 G-s
9 - MOTOR IB AXIAL	.124 In/Sec	.347 G-s

		OVERALL LEVEL	1-20 KHZ
10	- GEARBOX INPUT HORIZONTAL	.112 In/Sec	.324 G-s
11	- GEARBOX VERTICAL	.147 In/Sec	.277 G-s
12	- GEARBOX AXIAL	.148 In/Sec	.385 G-s
530-02	- PUMP,N.COOLING TWR,MIDDLE	(15-Jul-22)	
		OVERALL LEVEL	1-20 KHz
11	- MOT TOP N-S	.062 In/Sec	1.167 G-s
12	- MOTOR TOP E-W	.101 In/Sec	1.575 G-s
530-03	- PUMP,N.COOLING TWR,SOUTH	(15-Jul-22)	
		OVERALL LEVEL	1-20 KHz
11	- MOT TOP N-S	.106 In/Sec	.556 G-s
12	- MOTOR TOP E-W	.119 In/Sec	.666 G-s
548-7	- IRON-FREE H2O BOOSTER PUMP	(15-Jul-22)	
		OVERALL LEVEL	1-20 KHz
11	- MOTOR OUTBOARD HORIZONTAL	.028 In/Sec	.550 G-s
21	- MOTOR INBOARD HORIZONTAL	.041 In/Sec	1.279 G-s
23	- MOTOR INBOARD AXIAL	.037 In/Sec	.449 G-s
71	- PUMP HORIZONTAL	.040 In/Sec	.141 G-s
72	- PUMP VERTICAL	.027 In/Sec	.190 G-s
STC-NF	- S CT - NORTH FAN, S TWR	(15-Jul-22)	
		OVERALL LEVEL	1-20 KHz
1	- MOTOR OB HORIZ	.314 In/Sec	.403 G-s
2	- MOTOR IB HORIZ	.241 In/Sec	.188 G-s
3	- MOTOR IB AXIAL	.247 In/Sec	.080 G-s
		OVERALL LEVEL	1-20 KHZ
4	- GEARBOX AXIAL	.149 In/Sec	.324 G-s
5	- GEARBOX INPUT HORIZONTAL	.152 In/Sec	.476 G-s
STC-MF	- S CT - MID FAN, S TWR	(15-Jul-22)	
		OVERALL LEVEL	1-20 KHz
1	- MOTOR OB HORIZ	.280 In/Sec	.454 G-s
2	- MOTOR IB HORIZ	.243 In/Sec	.247 G-s
3	- MOTOR IB AXIAL	.127 In/Sec	.096 G-s
		OVERALL LEVEL	1-20 KHZ
4	- GEARBOX AXIAL	.108 In/Sec	.304 G-s
5	- GEARBOX INPUT HORIZONTAL	.139 In/Sec	.490 G-s
6	- GEARBOX VERTICAL	.088 In/Sec	.486 G-s
STC-SF	- S CT - SOUTH FAN, S TWR	(15-Jul-22)	
		OVERALL LEVEL	1-20 KHz
1	- MOTOR OB HORIZ	.159 In/Sec	.347 G-s
2	- MOTOR IB HORIZ	.230 In/Sec	.199 G-s
3	- MOTOR IB AXIAL	.252 In/Sec	.090 G-s
		OVERALL LEVEL	1-20 KHZ
4	- GEARBOX AXIAL	.125 In/Sec	.510 G-s
5	- GEARBOX INPUT HORIZONTAL	.090 In/Sec	.537 G-s
6	- GEARBOX VERTICAL	.288 In/Sec	.613 G-s
SCT-1	- SOUTH CT PUMP - EAST	(15-Jul-22)	
		OVERALL LEVEL	1-20 KHz
11	- MOTOR OUTBOARD HORIZONTAL	.035 In/Sec	2.619 G-s
21	- MOTOR INBOARD HORIZONTAL	.061 In/Sec	1.360 G-s
23	- MOTOR INBOARD AXIAL	.054 In/Sec	.543 G-s
71	- PUMP HORIZONTAL	.261 In/Sec	1.825 G-s
72	- PUMP VERTICAL	.126 In/Sec	1.802 G-s
SCT-2	- SOUTH CT PUMP - MID	(15-Jul-22)	
		OVERALL LEVEL	1-20 KHz
11	- MOTOR OUTBOARD HORIZONTAL	.033 In/Sec	3.491 G-s
21	- MOTOR INBOARD HORIZONTAL	.043 In/Sec	.953 G-s
23	- MOTOR INBOARD AXIAL	.056 In/Sec	1.574 G-s
71	- PUMP HORIZONTAL	.126 In/Sec	1.391 G-s
72	- PUMP VERTICAL	.138 In/Sec	1.436 G-s
SCT-3	- SOUTH CT PUMP - WEST	(15-Jul-22)	
		OVERALL LEVEL	1-20 KHz

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   11  - MOTOR OUTBOARD HORIZONTAL              .040 In/Sec       .621 G-s
   21  - MOTOR INBOARD HORIZONTAL               .043 In/Sec      1.206 G-s
   23  - MOTOR INBOARD AXIAL                    .068 In/Sec       .546 G-s
   71  - PUMP HORIZONTAL                        .169 In/Sec       .982 G-s
   72  - PUMP VERTICAL                          .158 In/Sec      1.029 G-s

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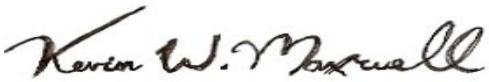
As always, it has been a pleasure to serve Arkema. If there are any comments or questions, do not hesitate to contact us.

Sincerely,



ISO Certified Vibration Analyst, Category III

HI-SPEED INDUSTRIAL SERVICE

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