HI-SPEED INDUSTRIAL SERVICE

MILLINGTON, TN

February 26, 2021

Arkema

Subject: February week 3/4 vibration service report

Most of the machines surveyed were found to be in good condition except for the following:

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

Hi-Speed Industrial Service tests and inspects industrial machinery and equipment and makes recommendations concerning maintenance and repairs based on its experience in the field of industrial repair and maintenance. The information contained herein is provided as an opinion only, not as a guaranty or warranty of the matters discussed herein.

This completes our assessment of your equipment for this survey. Thank you for your business and don't hesitate to call if you have any comments or questions.

Sincerely,

David W. Shook
Senior Reliability Specialists
Hi-Speed Industrial Service
dshook@gohispeed.com

7030 Ryburn Drive
Millington, TN 38053
P. 901-873-5300
F. 901-873-5301

Weekly Route Critical Equipment Observations

C Concentrator Vacuum Pump 2130-1
Unit was not running during the survey.

Agitator, Hydrogenator C 7001-01
The highest motor overall vibration is at 0.163"/sec velocity peak for the inboard vertical. We will continue to monitor normally. Gearbox looks good. No immediate issue.

A/B Concentrator Vacuum Pump 57
The outboard pump bearing overall is 0.255"/sec peak velocity, with a dominant vibration at 16 orders, which is most likely vane pass. We will continue to watch for changes. **Rated a Class I Defect.**

Flash Vacuum Pump 2130-1
All vibrations are below 0.1"/second velocity peak overall. No reportable issues.

Air Compressor C-201
Rotor bar vibrations are normal for this motor's history. The trend clearly shows that the vibrations vary considerably over time. We still believe these motors have possible weak rotor bar end connections that cause the vibrations to fluctuate higher due to loading. There are still blower case vibrations around 2.5-3 KHz. With a wide noise floor. We will continue to monitor this unit for changes. **Rated a Class I Defect**.

Air Compressor C-202
Rotor bar vibrations are normal for this motor's history. The trend clearly shows that the vibrations vary considerably over time. We still believe these motors have possible weak rotor bar end connections that cause the vibrations to fluctuate higher due to loading. There are still blower case vibrations around 2.5-3 KHz. With a wide noise floor. We will continue to monitor this unit for changes. **Rated a Class I Defect.**

Air Compressor C-203
We are still watching compressor vibrations at around 6.9 orders of input shaft speed with multiple harmonics of that fundamental vibration. The vibration peaks were always present; however, they jumped up starting in January. A more precise analysis could be reported if detailed information regarding compressor components could be provided. Rotor bar vibrations are normal for this motor's history. The trend clearly shows that the vibrations vary considerably over time. We still believe these motors have possible weak rotor bar end connections that cause the vibrations to fluctuate higher due to loading. There are still blower case vibrations around 2.5-3 KHz. With a wide noise floor. We will continue to monitor this unit for changes. **Rated a Class II Defect**.

Instrument Air Compressor
The male and female shaft vibrations still seem to show gear mesh and harmonics as well as a beat vibration occasionally. They continue to vary over time. Both shafts have between 5 and 7 g's RMS overall in the data. The dominant vibration appears to be the second gear mesh harmonic at near 2500 Hz. We are still watching this unit closely and will be going forward. **Rated a Class I Defect for now.**

Air Compressor NASH A 201-08A
Highest vibration is still in the pump itself at 0.289"/sec velocity peak for the outboard vertical. The vibration spectrum is still dominated by a 20-order vibration, which is thought to be vane pass. **Rated a Class I Defect.**

D Hydrogenator Agitator 9002-10
Highest overall vibration is at 0.195"/sec velocity peak for the gearbox. Vibrations are mostly sub-synchronous in nature. This is lower for this unit. We will watch carefully during the next few surveys. No immediate concern.

Reportable Monthly Equipment

Middle Mix Bed Water Pump 191-07
Dominant vibrations in the pump are at 2x and 5x of shaft RPM. This generally indicates a possible alignment issue as well as a flow or process issue. Ensure the pump is operation in the optimal part of the operational curve, the shafts are in precision alignment, and that the coupling is serviceable. **Rated a Class I Defect.**

H2 Monthly Equipment

H2 East Cooling Tower Pump
Pump vibrations have dropped since last survey. No immediate concern at this time.

H2 FD Fan
Motor shaft speed vibration is highest in the motor outboard data. Overall is 0.311"/sec velocity peak. Fan bearings show slight looseness. Inspect the coupling and all fasteners as time allows. **Rated A Class I Defect.**

****

Database: Arkema.rbm
Station: PEROXIDE
Route No. 5: ARK WK 3
Report Date: 01-Mar-21 09:46

MEASUREMENT POINT	OVERALL LEVEL	HFD / VHFD	MACHINE SPEED
7000-01 - AGITATOR,HYDROGENATOR C	(26-Feb-21)		
	OVERALL LEVEL	1-20 KHZ	
02	.039 In/Sec	.056 G-s	45.00 RPM
03	.034 In/Sec	.021 G-s	
11	.091 In/Sec	.597 G-s	1400.0 RPM
12	.121 In/Sec	.722 G-s	
13	.147 In/Sec	.205 G-s	
21	.094 In/Sec	.354 G-s	
22	.163 In/Sec	.205 G-s	
23	.144 In/Sec	.325 G-s	
31	.094 In/Sec	.610 G-s	
32	.082 In/Sec	.630 G-s	
33	.041 In/Sec	.240 G-s	
41	.087 In/Sec	.788 G-s	
42	.095 In/Sec	.845 G-s	
51	.081 In/Sec	.821 G-s	375.0 RPM
53	.077 In/Sec	.668 G-s	
61	.030 In/Sec	.369 G-s	
71	.053 In/Sec	.502 G-s	45.00 RPM
81	.019 In/Sec	.293 G-s	
83	.049 In/Sec	.260 G-s	
57 - A/B Concentr Vac Pmp-var RPM	(26-Feb-21)		
	OVERALL LEVEL	1-20 KHz	
11	.049 In/Sec	.713 G-s	900.0 RPM
12	.074 In/Sec	.361 G-s	
21	.068 In/Sec	.128 G-s	
23	.069 In/Sec	.291 G-s	
71	.132 In/Sec	.673 G-s	
81	.255 In/Sec	.728 G-s	
83	.097 In/Sec	1.074 G-s	
2130-1 - FLASH VAP VAC PUMP-var speed	(26-Feb-21)		
	OVERALL LEVEL	1-20 KHz	
11	.036 In/Sec	.187 G-s	1200.0 RPM
12	.031 In/Sec	.310 G-s	
21	.055 In/Sec	.280 G-s	
22	.038 In/Sec	.305 G-s	
23	.055 In/Sec	.164 G-s	
71	.053 In/Sec	.360 G-s	
72	.063 In/Sec	.393 G-s	
81	.068 In/Sec	.224 G-s	
82	.077 In/Sec	.505 G-s	
83	.040 In/Sec	.377 G-s	

C-203 - C-203 Comp (26-Feb-21)

	OVERALL LEVEL	1-20 KHz	
11	.041 In/Sec	1.374 G-s	3588.0 RPM
12	.077 In/Sec	2.377 G-s	
21	.031 In/Sec	.982 G-s	
22	.039 In/Sec	.685 G-s	
23	.057 In/Sec	2.189 G-s	
	OVERALL LEVEL	1-20 KHZ	
71M	.054 In/Sec	2.779 G-s	
72M	.053 In/Sec	2.684 G-s	
73M	.067 In/Sec	1.809 G-s	
81M	.063 In/Sec	5.414 G-s	
82M	.073 In/Sec	5.470 G-s	
71F	.066 In/Sec	2.506 G-s	
72F	.078 In/Sec	2.534 G-s	
73F	.068 In/Sec	2.516 G-s	
81F	.082 In/Sec	3.191 G-s	
82F	.063 In/Sec	1.768 G-s	

C-202 - C-202 Comp (26-Feb-21)

	OVERALL LEVEL	1-20 KHz	
11	.102 In/Sec	3.799 G-s	3588.0 RPM
12	.115 In/Sec	.579 G-s	
21	.061 In/Sec	.520 G-s	
22	.148 In/Sec	4.843 G-s	
23	.060 In/Sec	1.280 G-s	
	OVERALL LEVEL	1-20 KHZ	
71M	.043 In/Sec	1.667 G-s	
72M	.044 In/Sec	1.082 G-s	
73M	.071 In/Sec	.646 G-s	
81M	.082 In/Sec	3.874 G-s	
82M	.064 In/Sec	3.354 G-s	
71F	.051 In/Sec	2.218 G-s	
72F	.072 In/Sec	1.894 G-s	
73F	.075 In/Sec	2.721 G-s	
81F	.059 In/Sec	2.498 G-s	
82F	.048 In/Sec	.767 G-s	

C-201 - C-201 Comp (26-Feb-21)

	OVERALL LEVEL	1-20 KHz	
11	.089 In/Sec	.387 G-s	3588.0 RPM
12	.091 In/Sec	2.692 G-s	
21	.087 In/Sec	.543 G-s	
22	.062 In/Sec	.552 G-s	
23	.047 In/Sec	1.250 G-s	
	OVERALL LEVEL	1-20 KHZ	
71M	.047 In/Sec	1.402 G-s	
72M	.075 In/Sec	3.003 G-s	
73M	.065 In/Sec	1.471 G-s	
81M	.064 In/Sec	2.108 G-s	
82M	.072 In/Sec	2.499 G-s	
71F	.078 In/Sec	2.825 G-s	
72F	.059 In/Sec	1.982 G-s	
73F	.043 In/Sec	.787 G-s	
81F	.056 In/Sec	2.438 G-s	
82F	.079 In/Sec	2.353 G-s	

new AC	- INSTRUMENT AIR COMPRESSOR	(26-Feb-21)		
		OVERALL LEVEL	1-20 KHz	
	11	.139 In/Sec	1.036 G-s	1780.0 RPM
	12	.106 In/Sec	.739 G-s	
	13	.091 In/Sec	.425 G-s	
	21	.155 In/Sec	1.042 G-s	
	22	.078 In/Sec	.892 G-s	
	23	.066 In/Sec	1.345 G-s	
		OVERALL LEVEL	1-20 KHZ	
	71F	.146 In/Sec	5.651 G-s	
	72F	.148 In/Sec	2.945 G-s	
	73F	.179 In/Sec	5.414 G-s	
	81F	.138 In/Sec	2.762 G-s	
	82F	.213 In/Sec	6.314 G-s	
	83F	.159 In/Sec	3.266 G-s	
	71M	.097 In/Sec	4.199 G-s	
	72M	.151 In/Sec	6.275 G-s	
	73M	.133 In/Sec	4.698 G-s	
	81M	.178 In/Sec	4.882 G-s	
	82M	.244 In/Sec	7.189 G-s	
	83M	.222 In/Sec	.694 G-s	
201-08A	- COMPRESSOR,NASH A 201-08A	(26-Feb-21)		
		OVERALL LEVEL	1-20 KHz	
	11	.077 In/Sec	.157 G-s	506.3 RPM
	12	.073 In/Sec	.138 G-s	
	13	.154 In/Sec	.100 G-s	
	21	.066 In/Sec	.104 G-s	
	22	.111 In/Sec	.126 G-s	
	23	.160 In/Sec	.146 G-s	
	71	.152 In/Sec	.931 G-s	
	72	.229 In/Sec	1.398 G-s	
	73	.148 In/Sec	.209 G-s	
	81	.179 In/Sec	.490 G-s	
	82	.289 In/Sec	.322 G-s	
	83	.161 In/Sec	.532 G-s	
9002-10	- D-HYDROGENATOR AGITATOR	(26-Feb-21)		
		OVERALL LEVEL	1-20 KHz	
	11	.098 In/Sec	.039 G-s	1185.0 RPM
	21	.070 In/Sec	.096 G-s	
	23	.052 In/Sec	.090 G-s	
		OVERALL LEVEL	1-20 KHZ	
	31	.172 In/Sec	.551 G-s	
	31L	.095 In/Sec	.561 G-s	
		OVERALL LEVEL	1-20 KHz	
	51	.167 In/Sec	.153 G-s	
	51L	.160 In/Sec	.152 G-s	100.0 RPM
	52	.195 In/Sec	.272 G-s	
	52L	.170 In/Sec	.249 G-s	
	53	.101 In/Sec	.505 G-s	
	53L	.023 In/Sec	.488 G-s	
	61	.098 In/Sec	.141 G-s	
	61L	.100 In/Sec	.132 G-s	
	81	.030 In/Sec	.018 G-s	
	82	.035 In/Sec	.023 G-s	

	83	.025 In/Sec	.077 G-s	
NTC-SF	- N CT-SOUTH FAN, N TWR		(26-Feb-21)	
		OVERALL LEVEL	1-20 KHz	
	1	.276 In/Sec	.409 G-s	1780.0 RPM
	2	.268 In/Sec	.521 G-s	
	3	.248 In/Sec	.531 G-s	
		OVERALL LEVEL	1-20 KHZ	
	4	.211 In/Sec	.223 G-s	
	5	.0023 In/Sec	.0008 G-s	
	6	.100 In/Sec	.236 G-s	
	6L	.106 In/Sec	.242 G-s	
NCT - NF	- N CT -NORTH FAN, N TWR		(26-Feb-21)	
		OVERALL LEVEL	1-20 KHz	
	7	.108 In/Sec	.271 G-s	1780.0 RPM
	8	.104 In/Sec	.242 G-s	
	9	.467 In/Sec	.210 G-s	
		OVERALL LEVEL	1-20 KHZ	
	10	.155 In/Sec	.156 G-s	
	11	.103 In/Sec	.151 G-s	
	12	.115 In/Sec	.183 G-s	
530-02	- PUMP,N.COOLING TWR,MIDDLE		(26-Feb-21)	
		OVERALL LEVEL	1-20 KHz	
	11	.100 In/Sec	.444 G-s	1780.0 RPM
	12	.138 In/Sec	.555 G-s	
530-03	- PUMP,N.COOLING TWR,SOUTH		(26-Feb-21)	
		OVERALL LEVEL	1-20 KHz	
	11	.117 In/Sec	.457 G-s	1780.0 RPM
	12	.143 In/Sec	.412 G-s	
548-7	- IRON-FREE H2O BOOSTER PUMP		(26-Feb-21)	
		OVERALL LEVEL	1-20 KHz	
	11	.016 In/Sec	.550 G-s	1800.0 RPM
	21	.020 In/Sec	.751 G-s	
	23	.050 In/Sec	.307 G-s	
	71	.031 In/Sec	.137 G-s	
	72	.027 In/Sec	.134 G-s	
STC-NF	- S CT - NORTH FAN, S TWR		(26-Feb-21)	
		OVERALL LEVEL	1-20 KHz	
	1	.287 In/Sec	.388 G-s	1780.0 RPM
	2	.229 In/Sec	.248 G-s	
	3	.446 In/Sec	.107 G-s	
		OVERALL LEVEL	1-20 KHZ	
	4	.139 In/Sec	.371 G-s	
	5	.120 In/Sec	.478 G-s	
STC-MF	- S CT - MID FAN, S TWR		(26-Feb-21)	
		OVERALL LEVEL	1-20 KHz	
	1	.265 In/Sec	.408 G-s	1780.0 RPM
	2	.217 In/Sec	.072 G-s	
	3	.131 In/Sec	.103 G-s	
		OVERALL LEVEL	1-20 KHZ	
	4	.087 In/Sec	.307 G-s	

5	.106 In/Sec	.436 G-s	
6	.073 In/Sec	.494 G-s	

STC-SF - S CT - SOUTH FAN, S TWR (26-Feb-21)

	OVERALL LEVEL	1-20 KHz	
1	.235 In/Sec	.449 G-s	1780.0 RPM
2	.262 In/Sec	.259 G-s	
3	.257 In/Sec	.106 G-s	
	OVERALL LEVEL	1-20 KHZ	
4	.153 In/Sec	.529 G-s	
5	.096 In/Sec	.582 G-s	
6	.296 In/Sec	.697 G-s	

SCT-1 - SOUTH CT PUMP - EAST (26-Feb-21)

	OVERALL LEVEL	1-20 KHz	
11	.034 In/Sec	.572 G-s	1800.0 RPM
21	.031 In/Sec	1.750 G-s	
23	.031 In/Sec	.241 G-s	
71	.158 In/Sec	.500 G-s	
72	.071 In/Sec	.752 G-s	

SCT-2 - SOUTH CT PUMP - MID (26-Feb-21)

	OVERALL LEVEL	1-20 KHz	
11	.052 In/Sec	.174 G-s	1800.0 RPM
21	.036 In/Sec	.819 G-s	
23	.059 In/Sec	.504 G-s	
71	.078 In/Sec	.417 G-s	
72	.051 In/Sec	.367 G-s	

SCT-3 - SOUTH CT PUMP - WEST (26-Feb-21)

	OVERALL LEVEL	1-20 KHz	
11	.025 In/Sec	.757 G-s	1800.0 RPM
21	.042 In/Sec	.711 G-s	
23	.072 In/Sec	.250 G-s	
71	.114 In/Sec	.338 G-s	
72	.074 In/Sec	.397 G-s	

192-03 - Two Stage Water Pump A-WEST (26-Feb-21)

	OVERALL LEVEL	1-20 KHz	
11	.094 In/Sec	.062 G-s	1765.0 RPM
21	.086 In/Sec	.324 G-s	
23	.052 In/Sec	.186 G-s	
71	.171 In/Sec	.817 G-s	
72	.063 In/Sec	.749 G-s	

191-07 - M MIX BED WATER PUMP 191-07 (26-Feb-21)

	OVERALL LEVEL	1-20 KHz	
11	.090 In/Sec	1.047 G-s	3600.0 RPM
21	.082 In/Sec	.729 G-s	
23	.077 In/Sec	.172 G-s	
71	.284 In/Sec	.218 G-s	
72	.179 In/Sec	.278 G-s	

Clarification Of Vibration Units:

Acc --> G-s PK

Vel --> In/Sec PK Abbreviated Last Measurement Summary

****

Database: Arkema.rbm
Station: HYDROGEN
Route No. 1: H2 MONTHLY
Report Date: 01-Mar-21 09:46

MEASUREMENT POINT		OVERALL LEVEL	HFD / VHFD	MACHINE SPEED
P2A	- PUMP MEA CIRC WEST P2A	(26-Feb-21)		
		OVERALL LEVEL	1-20 KHz	
	11	.071 In/Sec	.265 G-s	3585.0 RPM
	21	.049 In/Sec	.482 G-s	
	23	.045 In/Sec	.303 G-s	
	71	.218 In/Sec	.426 G-s	
	72	.143 In/Sec	.436 G-s	
P1A	- PUMP BFW WEST P1A	(26-Feb-21)		
		OVERALL LEVEL	1-20 KHz	
	11	.075 In/Sec	.167 G-s	3600.0 RPM
	21	.106 In/Sec	.864 G-s	
	23	.125 In/Sec	.460 G-s	
	71	.127 In/Sec	.807 G-s	
	72	.117 In/Sec	.748 G-s	
	81	.114 In/Sec	.450 G-s	
	82	.128 In/Sec	.537 G-s	
	83	.041 In/Sec	1.346 G-s	
C2	- FD BLOWER C2	(26-Feb-21)		
		OVERALL LEVEL	1-20 KHz	
	11	.311 In/Sec	.273 G-s	3600.0 RPM
	21	.283 In/Sec	.423 G-s	
	23	.186 In/Sec	.137 G-s	
	71	.211 In/Sec	1.581 G-s	
	81	.258 In/Sec	1.677 G-s	
C1	- ID -BLOWER C1	(26-Feb-21)		
		OVERALL LEVEL	1-20 KHz	
	11	.121 In/Sec	.184 G-s	1800.0 RPM
	21	.153 In/Sec	.519 G-s	
	23	.191 In/Sec	.313 G-s	
	71	.113 In/Sec	.784 G-s	
	72	.084 In/Sec	1.358 G-s	
	81	.212 In/Sec	1.207 G-s	
	82	.196 In/Sec	.958 G-s	
CTPE	- EAST COOLING TOWER PUMP	(26-Feb-21)		
		OVERALL LEVEL	1-20 KHz	
	11	.222 In/Sec	1.381 G-s	1750.0 RPM
	21	.083 In/Sec	.319 G-s	
	23	.106 In/Sec	.696 G-s	
	71	.230 In/Sec	.491 G-s	
	72	.322 In/Sec	.561 G-s	

CTPW	- WEST COOLING TOWER PUMP	(26-Feb-21)		
		OVERALL LEVEL	1-20 KHz	
11		.101 In/Sec	.384 G-s	1750.0 RPM
21		.088 In/Sec	.209 G-s	
23		.075 In/Sec	.789 G-s	
71		.153 In/Sec	.979 G-s	
72		.134 In/Sec	1.290 G-s	

Clarification Of Vibration Units:

Acc	-->	G-s	PK
Vel	-->	In/Sec	PK