HI-SPEED INDUSTRIAL SERVICE

MILLINGTON, TN

September 14, 2020

Arkema

Subject: September week 2 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 Peroxide Route Critical Equipment Observations

C Concentrator Vacuum Pump 2130-1
Vibrations appear to be normal this survey. No vibration is above 0.156"/sec velocity peak. No actions required.

Agitator, Hydrogenator C 7001-01
The highest motor overall vibrations are 0.191"/sec velocity peak for the inboard axial. Data shows multiple lower frequency harmonics of shaft speed as well as non-synchronous peaks in the upper frequencies. The bearings and fits in the replacement motor could be in some distress. A vibration at near 3x RPM is dominant and could possibly indicate a coupling or alignment issue.
Motor is rated a Class I Defect.

A/B Concentrator Vacuum Pump 57
This unit's motor vibration is still below 0.10"/sec velocity peak. The outboard pump bearing overall is 0.370"/sec peak velocity, with a dominant vibration at 16 orders, which is most likely blade pass. We will continue to watch for changes. **Rated a Class I Defect.**

Flash Vacuum Pump 2130-1
Vibrations appear to be normal this survey. All velocity measurements are below 0.10"/sec peak. No actions required.

Air Compressor C-201
Rotor bar vibrations are somewhat elevated 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. We will continue to monitor this unit for changes. **Rated a Class I Defect**. No actions required.

Air Compressor C-202
Rotor bar vibrations are low for this motor's history. The trend clearly shows that the vibrations vary considerably over time. We are still watching an increase in acceleration for the compressor section. **Rated a Class I Defect**. No immediate actions required at this time.

Air Compressor C-203
Rotor bar vibrations are normal for this motor's history. The waterfall spectra clearly show 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. **Rated a Class I Defect**. No actions required.

Instrument Air Compressor
The male and female shaft vibrations still seem to show gear mesh and harmonics as well as a beat vibration occasionally. The male shaft outboard axial overall vibration is at to 11 g's RMS. The dominant vibration appears to be the second gear mesh harmonic at near 2500 Hz. Two other harmonic vibrations at near 1500 and 1600 Hz are beating near 120 Hz. The beat is strong sometimes since the vibrations are close and of nearly equal amplitude. We will keep a close eye on this unit going forward. **Rated a Class I Defect for now.**

Air Compressor NASH A 201-08A
Highest vibration is still in the pump itself at just over 0.261"/sec velocity peak for the outboard vertical. The vibration spectrum is dominated by a 20-order vibration, which is thought to be vane pass. **Rated a Class I Defect.**

D Hydrogenator Agitator 9002-10
Vibration data shows an increase in vibrations this survey. Highest overall vibration is 0.270"/sec velocity peak for the gearbox top bearing plate in the N/S direction. **Still rated a Class I Defect.**

Monthly Equipment on report

191-07 Middle Mix Bed Water Pump
The pump still exhibits a vane pass vibration. Amplitude is 0.370"/sec velocity peak for the pump horizontal input.

Hydrogen ID Blower C1
Outboard fan bearing overall is just above our threshold. Clean the fan wheel, trim balance, and check the bearing clearances. **Rated a Class I Defect.**

Hydrogen East Cooling Tower Pump
The pump has a strong shaft speed vibration over 0.4"/sec velocity peak. Check foot bolts, coupling and alignment. Impeller could be at fault also. **Rated a Class II Defect.**

Abbreviated Last Measurement Summary

****

Database: Arkema.rbm
Station: PEROXIDE
Route No. 4: ARK WK 2
Report Date: 14-Sep-20 14:28

MEASUREMENT POINT	OVERALL LEVEL	HFD / VHFD
2130-1old - C Concentrator Vacuum Pump	(14-Sep-20)	
	OVERALL LEVEL	1-20 KHz
11 - Motor OB HOR	.070 In/Sec	.477 G-s
21 - Motor IB HOR	.065 In/Sec	.360 G-s
23 - Motor IB AXIAL	.120 In/Sec	.200 G-s
71 - Compressor IB HOR	.101 In/Sec	.826 G-s
81 - Compressor OB Horiz	.156 In/Sec	.688 G-s
83 - Compressor OB Axial	.080 In/Sec	1.816 G-s
7000-01 - AGITATOR,HYDROGENATOR C	(14-Sep-20)	
	OVERALL LEVEL	1-20 KHZ
02 - DRIVESHAFT BRG-EAST-WEST	.040 In/Sec	.035 G-s
03 - DRIVESHAFT BRG-VERTICAL	.047 In/Sec	.066 G-s
11 - C Hydro Agitator MOTOR OB HORIZ	.109 In/Sec	.779 G-s
12 - C Hydro Agitator MOTOR OB VERT	.121 In/Sec	.828 G-s
13 - C Hydro Agitator Motor OB Axial	.182 In/Sec	.537 G-s
21 - C Hydro Agitator MOTOR IB HORIZ	.132 In/Sec	.275 G-s
22 - C Hydro Agitator MOTOR IB VERT	.191 In/Sec	.493 G-s
23 - C Hydro Agitator Motor IB Axial	.162 In/Sec	.280 G-s
31 - C Hydro Agitator GrBx In Horizon	.098 In/Sec	.709 G-s
32 - C Hydro Agitator GrBx In VERT	.093 In/Sec	.817 G-s
33 - C Hydro Agitator GrBx In Axial	.060 In/Sec	.527 G-s
41 - C Hydro Agitator GrBx Top HZ E-W	.051 In/Sec	.571 G-s
42 - C Hydro Agitator GrBx TOP HZ N-S	.022 In/Sec	.399 G-s
51 - C Hydro Agitator GrBx BOT HZ E-W	.042 In/Sec	.621 G-s
52 - C Hydro Agitator GrBx BOT HZ N-S	.023 In/Sec	.386 G-s
53 - C Hydro Agitator GrBx Top Axial	.053 In/Sec	.450 G-s
57 - A/B Concentr Vac Pmp-var RPM	(14-Sep-20)	
	OVERALL LEVEL	1-20 KHz
11 - Motor OB HOR	.053 In/Sec	.304 G-s
12 - Motor OB VERT	.048 In/Sec	.381 G-s
21 - Motor IB HOR	.064 In/Sec	.302 G-s
23 - Motor IB AXIAL	.064 In/Sec	.207 G-s
71 - Compressor IB HOR	.122 In/Sec	.637 G-s
81 - Compressor OB Horiz	.370 In/Sec	.641 G-s
83 - Compressor OB Axial	.180 In/Sec	.759 G-s
2130-1 - FLASH VAP VAC PUMP-var speed	(14-Sep-20)	
	OVERALL LEVEL	1-20 KHz
11 - Motor OB HOR	.061 In/Sec	.181 G-s
12 - Motor OB VERT	.036 In/Sec	.515 G-s
21 - Motor IB HOR	.039 In/Sec	.711 G-s

22 - Motor IB VERT	.048 In/Sec	.742 G-s
23 - Motor IB AXIAL	.059 In/Sec	.370 G-s
71 - Compressor IB HOR	.060 In/Sec	.350 G-s
72 - Compressor IB VERT	.069 In/Sec	.427 G-s
81 - Compressor OB Horiz	.076 In/Sec	.227 G-s
82 - Compressor OB VERT	.078 In/Sec	.335 G-s
83 - Compressor OB Axial	.036 In/Sec	.386 G-s

C-203 - C-203 Comp	(14-Sep-20)	
	OVERALL LEVEL	1-20 KHz
11 - MOTOR OB HOR	.033 In/Sec	.862 G-s
12 - MOTOR OB VERT	.078 In/Sec	3.845 G-s
21 - MOTOR IB HOR	.022 In/Sec	.198 G-s
22 - MOTOR IB VERT	.049 In/Sec	1.417 G-s
23 - MOTOR IB AXIAL	.024 In/Sec	.399 G-s
	OVERALL LEVEL	1-20 KHZ
71M - COMP MALE SHAFT IB HOR	.034 In/Sec	.633 G-s
72M - COMP MALE SHAFT IB VERT	.044 In/Sec	2.670 G-s
73M - COMP MALE SHAFT IB AXIAL	.049 In/Sec	2.990 G-s
81M - COMP MALE SHAFT OB HOR	.047 In/Sec	2.055 G-s
82M - COMP MALE SHAFT OB VERT	.066 In/Sec	3.706 G-s
71F - COMP FEMALE SHAFT IB HOR	.048 In/Sec	1.804 G-s
72F - COMP FEMALE SHAFT IB VERT	.035 In/Sec	.781 G-s
73F - COMP FEMALE SHAFT IB AXIAL	.081 In/Sec	5.611 G-s
81F - COMP FEMALE SHAFT OB HOR	.050 In/Sec	3.045 G-s
82F - COMP FEMALE SHAFT OB VERT	.044 In/Sec	1.412 G-s

C-202 - C-202 Comp	(14-Sep-20)	
	OVERALL LEVEL	1-20 KHz
11 - MOTOR OB HOR	.063 In/Sec	.955 G-s
12 - MOTOR OB VERT	.105 In/Sec	.456 G-s
21 - MOTOR IB HOR	.056 In/Sec	.943 G-s
22 - MOTOR IB VERT	.104 In/Sec	.723 G-s
23 - MOTOR IB AXIAL	.041 In/Sec	.684 G-s
	OVERALL LEVEL	1-20 KHZ
71M - COMP MALE SHAFT IB HOR	.045 In/Sec	2.320 G-s
72M - COMP MALE SHAFT IB VERT	.050 In/Sec	2.475 G-s
73M - COMP MALE SHAFT IB AXIAL	.076 In/Sec	1.755 G-s
81M - COMP MALE SHAFT OB HOR	.036 In/Sec	2.114 G-s
82M - COMP MALE SHAFT OB VERT	.057 In/Sec	1.714 G-s
71F - COMP FEMALE SHAFT IB HOR	.038 In/Sec	2.549 G-s
72F - COMP FEMALE SHAFT IB VERT	.069 In/Sec	1.496 G-s
73F - COMP FEMALE SHAFT IB AXIAL	.074 In/Sec	5.532 G-s
81F - COMP FEMALE SHAFT OB HOR	.046 In/Sec	1.504 G-s
82F - COMP FEMALE SHAFT OB VERT	.054 In/Sec	1.107 G-s

C-201 - C-201 Comp	(14-Sep-20)	
	OVERALL LEVEL	1-20 KHz
11 - MOTOR OB HOR	.088 In/Sec	1.268 G-s
12 - MOTOR OB VERT	.130 In/Sec	4.260 G-s
21 - MOTOR IB HOR	.089 In/Sec	.725 G-s
22 - MOTOR IB VERT	.063 In/Sec	.220 G-s
23 - MOTOR IB AXIAL	.060 In/Sec	.652 G-s
	OVERALL LEVEL	1-20 KHZ
71M - COMP MALE SHAFT IB HOR	.052 In/Sec	2.010 G-s
72M - COMP MALE SHAFT IB VERT	.035 In/Sec	1.353 G-s
73M - COMP MALE SHAFT IB AXIAL	.081 In/Sec	2.372 G-s

81M - COMP MALE SHAFT OB HOR		.066 In/Sec	3.472 G-s
82M - COMP MALE SHAFT OB VERT		.055 In/Sec	1.988 G-s
71F - COMP FEMALE SHAFT IB HOR		.058 In/Sec	2.966 G-s
72F - COMP FEMALE SHAFT IB VERT		.041 In/Sec	.667 G-s
73F - COMP FEMALE SHAFT IB AXIAL		.057 In/Sec	2.196 G-s
81F - COMP FEMALE SHAFT OB HOR		.058 In/Sec	2.319 G-s
82F - COMP FEMALE SHAFT OB VERT		.047 In/Sec	1.792 G-s

new AC	- INSTRUMENT AIR COMPRESSOR	(14-Sep-20)	
		OVERALL LEVEL	1-20 KHz
11	- MOTOR OB HOR	.124 In/Sec	.905 G-s
12	- MOTOR OB VERT	.104 In/Sec	.584 G-s
13	- MOTOR OB AXIAL	.068 In/Sec	.640 G-s
21	- MOTOR IB HOR	.151 In/Sec	1.315 G-s
22	- MOTOR IB VERT	.079 In/Sec	.991 G-s
23	- MOTOR IB AXIAL	.052 In/Sec	.882 G-s
		OVERALL LEVEL	1-20 KHZ
71F	- COMP FEMALE SHAFT IB HOR	.239 In/Sec	8.740 G-s
72F	- COMP FEMALE SHAFT IB VERT	.168 In/Sec	3.977 G-s
73F	- COMP FEMALE SHAFT IB AXIAL	.159 In/Sec	3.902 G-s
81F	- COMP FEMALE SHAFT OB HOR	.151 In/Sec	3.260 G-s
82F	- COMP FEMALE SHAFT OB VERT	.272 In/Sec	7.440 G-s
83F	- COMP FEMALE SHAFT OB AXIAL	.162 In/Sec	3.117 G-s
71M	- COMP MALE SHAFT IB HOR	.106 In/Sec	5.995 G-s
72M	- COMP MALE SHAFT IB VERT	.176 In/Sec	6.197 G-s
73M	- COMP MALE SHAFT IB AXIAL	.135 In/Sec	5.694 G-s
81M	- COMP MALE SHAFT OB HOR	.214 In/Sec	5.902 G-s
82M	- COMP MALE SHAFT OB VERT	.246 In/Sec	7.108 G-s
83M	- COMP MALE SHAFT OB AXIAL	.319 In/Sec	11.52 G-s

201-08A	- COMPRESSOR,NASH A 201-08A	(14-Sep-20)	
		OVERALL LEVEL	1-20 KHz
11	- Nash Compr A Motor OB Horiz	.061 In/Sec	.222 G-s
12	- Nash Compr A Motor OB Vertical	.074 In/Sec	.134 G-s
13	- Nash Compr A Motor OB Axial	.145 In/Sec	.106 G-s
21	- Nash Compr A Motor IB Horiz	.065 In/Sec	.105 G-s
22	- Nash Compr A Motor IB VERT	.084 In/Sec	.137 G-s
23	- Nash Compr A Motor IB AXIAL	.135 In/Sec	.133 G-s
71	- Nash Compr A COMP IB HORIZ	.139 In/Sec	.859 G-s
72	- Nash Compr A Compressor IB Verti	.207 In/Sec	.411 G-s
73	- Nash Compr A COMP IB AXIAL	.136 In/Sec	.280 G-s
81	- Nash Compr A COMP OB HORIZ	.145 In/Sec	.515 G-s
82	- Nash Compr A Compressor OB Verti	.261 In/Sec	.520 G-s
83	- Nash Compr A Compressor OB Axial	.115 In/Sec	.296 G-s

202-05	- NASH SEAL LIQUID PUMP-A	(14-Sep-20)	
		OVERALL LEVEL	1-20 KHz
11	- MOTOR OUTBOARD HORIZ	.050 In/Sec	.064 G-s
21	- MOTOR INBOARD HORIZ	.014 In/Sec	.106 G-s
23	- MOTOR INBOARD AXIAL	.028 In/Sec	.067 G-s
71	- PUMP HORIZ	.028 In/Sec	.071 G-s
72	- PUMP VERT	.018 In/Sec	.053 G-s

9002-10	- D-HYDROGENATOR AGITATOR	(14-Sep-20)	
		OVERALL LEVEL	1-20 KHz
11	- MOTOR OUTBOARD HORIZONTAL	.084 In/Sec	.039 G-s
21	- MOTOR INBOARD HORIZONTAL	.094 In/Sec	.185 G-s

23	- MOTOR INBOARD AXIAL	.046 In/Sec	.098 G-s
31	- GEARBOX INPUT SHAFT -HORIZONTAL	.229 In/Sec	.618 G-s
51	- GEARBOX TOP PLATE- E-W	.270 In/Sec	.129 G-s
52	- GEARBOX TOP PLATE- N-S	.182 In/Sec	.223 G-s
53	- GEARBOX OUTPUT TOP -VERTICAL	.118 In/Sec	.737 G-s
61	- GEARBOX BOTTOM E-W-HORIZONTAL	.155 In/Sec	.109 G-s
81	- AGIT INTERMED BRG @ SEAL- N-S	.042 In/Sec	.025 G-s
82	- AGIT INTERMED BRG @ SEAL- E-W	.036 In/Sec	.023 G-s
83	- AGIT INTERMED BRG @ SEAL- VERT	.035 In/Sec	.119 G-s

9003-01	- D-HYDRO PRIMARY FILT FD PUMP	(14-Sep-20)	
		OVERALL LEVEL	1-20 KHz
11	- MOTOR OUTBOARD HORIZONTAL	.074 In/Sec	.102 G-s
21	- MOTOR INBOARD HORIZONTAL	.082 In/Sec	.272 G-s
23	- MOTOR INBOARD AXIAL	.043 In/Sec	.254 G-s
71	- PUMP HORIZONTAL	.107 In/Sec	.205 G-s
72	- PUMP VERTICAL	.103 In/Sec	.225 G-s

9001-01	- D-HYDRO SECOND. FILT FD PUMP	(14-Sep-20)	
		OVERALL LEVEL	1-20 KHz
11	- MOTOR OUTBOARD HORIZONTAL	.042 In/Sec	.202 G-s
21	- MOTOR INBOARD HORIZONTAL	.044 In/Sec	.244 G-s
23	- MOTOR INBOARD AXIAL	.032 In/Sec	.265 G-s
71	- PUMP HORIZONTAL	.078 In/Sec	.278 G-s
72	- PUMP VERTICAL	.052 In/Sec	.247 G-s

192-03	- Two Stage Water Pump A-WEST	(14-Sep-20)	
		OVERALL LEVEL	1-20 KHz
11	- MOTOR OUTBOARD HORIZONTAL	.057 In/Sec	.137 G-s
21	- MOTOR IB HORIZ	.063 In/Sec	.234 G-s
23	- motor inboard axial	.042 In/Sec	.177 G-s
71	- PUMP HORIZONTAL	.090 In/Sec	.373 G-s
72	- PUMP VERTICAL	.061 In/Sec	.304 G-s

191-07	- M MIX BED WATER PUMP 191-07	(14-Sep-20)	
		OVERALL LEVEL	1-20 KHz
11	- Chilled H2O Pump Motor OB Horizo	.170 In/Sec	.478 G-s
21	- Chilled H2O Pump Motor IB Horizo	.149 In/Sec	.670 G-s
23	- MOTOR INBOARD	.056 In/Sec	.192 G-s
71	- Chilled H2O Pump IB Horizontal	.371 In/Sec	.311 G-s
72	- PUMP VERTICAL	.102 In/Sec	.294 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: 14-Sep-20 14:29

MEASUREMENT POINT	OVERALL LEVEL	HFD / VHFD

P2A	- PUMP MEA CIRC WEST P2A	(14-Sep-20)		
		OVERALL LEVEL	1-20 KHz	
11	- West MEA Circ Pmp Mtr OB Horizon	.064 In/Sec	.300 G-s	
21	- West MEA Circ Pmp Mtr IB Horizon	.045 In/Sec	.184 G-s	
23	- motor inboard axial	.054 In/Sec	.111 G-s	
71	- West MEA Circ Pmp Pump IB Horizo	.176 In/Sec	.327 G-s	
72	- pump vertical	.119 In/Sec	.397 G-s	
P1A	- PUMP BFW WEST P1A	(14-Sep-20)		
		OVERALL LEVEL	1-20 KHz	
11	- Mtr OB Horizo	.111 In/Sec	.124 G-s	
21	- Mtr IB Horizo	.113 In/Sec	.687 G-s	
23	- motor axial	.100 In/Sec	.359 G-s	
71	- Pump IB HORIZ	.077 In/Sec	.339 G-s	
72	- Pump IB Vertical	.091 In/Sec	.476 G-s	
81	- Pump OB HORIZ	.110 In/Sec	.376 G-s	
82	- Pump OB Vertical	.114 In/Sec	.329 G-s	
83	- OB Axial	.037 In/Sec	.242 G-s	
C2	- FD BLOWER C2	(14-Sep-20)		
		OVERALL LEVEL	1-20 KHz	
11	- F.D.Fan Motor OB Horizontal	.143 In/Sec	.327 G-s	
21	- F.D.Fan Motor I Horizontal	.118 In/Sec	.439 G-s	
23	- F.D.Fan Motor AXIAL INBOARD	.253 In/Sec	1.259 G-s	
71	- F.D.Fan Coupling End Brg Horizon	.084 In/Sec	1.730 G-s	
81	- F.D.Fan Fan End Brg Horizon	.134 In/Sec	1.044 G-s	
C1	- ID -BLOWER C1	(14-Sep-20)		
		OVERALL LEVEL	1-20 KHz	
11	- I.D.Fan Motor OB Horizontal	.134 In/Sec	.296 G-s	
21	- I.D.Fan Motor IB Horizontal	.165 In/Sec	.225 G-s	
23	- motor inboard axial	.217 In/Sec	.170 G-s	
71	- I.D.Fan Coupling End Horizontal	.133 In/Sec	.911 G-s	
72	- I.D.Fan Coupling End VERTICAL	.094 In/Sec	.916 G-s	
81	- I.D.Fan Fan End Horizontal	.268 In/Sec	1.361 G-s	
82	- I.D.Fan Fan End VERTICAL	.235 In/Sec	1.235 G-s	
CTPE	- EAST COOLING TOWER PUMP	(14-Sep-20)		
		OVERALL LEVEL	1-20 KHz	
11	- MOTOR OUTBOARD HORIZONTAL	.229 In/Sec	1.790 G-s	
21	- MOTOR INBOARD HORIZONTAL	.056 In/Sec	.503 G-s	
23	- MOTOR INBOARD AXIAL	.236 In/Sec	.739 G-s	
71	- PUMP HORIZONTAL	.149 In/Sec	.958 G-s	
72	- PUMP VERTICAL	.420 In/Sec	.813 G-s	
CTPW	- WEST COOLING TOWER PUMP	(14-Sep-20)		
		OVERALL LEVEL	1-20 KHz	
11	- MOTOR OUTBOARD HORIZONTAL	.103 In/Sec	.685 G-s	
21	- MOTOR INBOARD HORIZONTAL	.102 In/Sec	.693 G-s	
23	- MOTOR INBOARD AXIAL	.072 In/Sec	.717 G-s	
71	- PUMP HORIZONTAL	.183 In/Sec	1.156 G-s	
72	- PUMP VERTICAL	.096 In/Sec	1.313 G-s	

Clarification Of Vibration Units:

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