HI-SPEED INDUSTRIAL SERVICE

MILLINGTON, TN

July 6, 2020

ARKEMA
Subject: July week 1 vibration service report

Weekly Peroxide Route Critical Equipment Observations

C Concentrator Vacuum Pump 2130-1
The pump axial and radial vibrations are acceptable. No action is required.

A/B Concentrator Vacuum Pump 57
Exterior water is still on the pump unit this month. The outboard bearing horizontal vibration has dropped back down below 0.3" to 0.295"/sec velocity peak overall. The vibration is dominated by a 16-order peak, which is most likely vane pass. The vibration will shorten the life of the unit. **Rated a Class I Defect**.

Agitator, Hydrogenator C 7001-01
The highest motor overall is 0.162"/sec velocity peak again for the inboard axial vibration. The motor speed today was read from the data to be about 1,359 RPM. 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 3x RPM vibration is dominant and could indicate a coupling or alignment issue. **Motor is rated a Class I Defect now.**

Flash Vacuum Pump 2130-1
Vibrations appear to be normal this survey. No actions required.

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. We will continue to monitor this unit for changes No actions required.

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 will watch this unit closely for changes. No immediate actions required at this time.

Air Compressor C-203
Rotor bar vibrations are slightly 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. No actions required.

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Instrument Air Compressor new
The male and female shaft vibrations seem to show gear mesh and harmonics as well as a beat vibration occasionally. 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 0.258”/sec velocity peak for the outboard vertical. **Rated a Class I Defect.**

D Hydrogenator Agitator 9002-10
Vibration data shows a change in vibrations this survey. Highest amplitude is only 0.214”/sec velocity peak for the input pinion horizontal which is a complete change from the normal top vibration in the unit. **Still rated a Class I Defect.**

Monthly Route Equipment with issues

West Oxidizer Feed Pump 7016-11
Recently added acceleration trend has increased this survey for the pump measurements to 2.5 g's RMS. Random impacting can be seen in the time domain. We will add this unit and watch it for changes. **Rated a Class I Defect**.

Hydrogen Boiler Feed Water Pump P1B
The motor drive end bearing could be suffering from an outer race defect. Vibrations are over 5 g's RMS overall. We will watch the unit carefully going forward and update the defect rating and recommendations as needed. **Rated a Class I Defect.**

Hydrogen ID Blower C1
The fan unit outboard bearing still suffers from some form of mechanical looseness and possibly imbalance in the wheel. Check the fasteners and clearances as time allows. Check balance and trim if necessary, after maintenance. **Rated a Class I Defect.**

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 Specialist
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Hi-Speed **Industrial Service**

Abbreviated Last Measurement Summary

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Database: Arkema.rbm
Station: PEROXIDE
Route No. 3: ARK WK 1
Report Date: 06-Jul-20 13:02

MEASUREMENT POINT	OVERALL LEVEL	HFD / VHFD
2130-1old - C Concentrator Vacuum Pump	(06-Jul-20)	
	OVERALL LEVEL	1-20 KHz
11 - Motor OB HOR	.086 In/Sec	.341 G-s
21 - Motor IB HOR	.101 In/Sec	.438 G-s
23 - Motor IB AXIAL	.127 In/Sec	.224 G-s
71 - Compressor IB HOR	.123 In/Sec	1.017 G-s
81 - Compressor OB Horiz	.185 In/Sec	.806 G-s
83 - Compressor OB Axial	.097 In/Sec	2.340 G-s
7000-01 - AGITATOR,HYDROGENATOR C	(06-Jul-20)	
	OVERALL LEVEL	1-20 KHZ
01 - DRIVESHAFT BRG-NORTH-SOUTH	.040 In/Sec	.046 G-s
02 - DRIVESHAFT BRG-EAST-WEST	.046 In/Sec	.048 G-s
03 - DRIVESHAFT BRG-VERTICAL	.046 In/Sec	.063 G-s
11 - C Hydro Agitator MOTOR OB HORIZ	.101 In/Sec	.979 G-s
12 - C Hydro Agitator MOTOR OB VERT	.099 In/Sec	.854 G-s
13 - C Hydro Agitator Motor OB Axial	.151 In/Sec	.367 G-s
21 - C Hydro Agitator MOTOR IB HORIZ	.117 In/Sec	.229 G-s
22 - C Hydro Agitator MOTOR IB VERT	.156 In/Sec	.552 G-s
23 - C Hydro Agitator Motor IB Axial	.162 In/Sec	.324 G-s
31 - C Hydro Agitator GrBx In Horizon	.101 In/Sec	.733 G-s
32 - C Hydro Agitator GrBx In VERT	.087 In/Sec	.864 G-s
33 - C Hydro Agitator GrBx In Axial	.052 In/Sec	.403 G-s
41 - C Hydro Agitator GrBx Top HZ E-W	.051 In/Sec	.661 G-s
42 - C Hydro Agitator GrBx TOP HZ N-S	.030 In/Sec	.592 G-s
51 - C Hydro Agitator GrBx BOT HZ E-W	.021 In/Sec	.270 G-s
52 - C Hydro Agitator GrBx BOT HZ N-S	.019 In/Sec	.700 G-s
53 - C Hydro Agitator GrBx Top Axial	.046 In/Sec	.462 G-s
57 - A/B Concentr Vac Pmp-var RPM	(06-Jul-20)	
	OVERALL LEVEL	1-20 KHz
11 - Motor OB HOR	.056 In/Sec	.270 G-s
12 - Motor OB VERT	.060 In/Sec	.390 G-s
21 - Motor IB HOR	.097 In/Sec	.517 G-s
23 - Motor IB AXIAL	.053 In/Sec	.230 G-s
71 - Compressor IB HOR	.116 In/Sec	.478 G-s
81 - Compressor OB Horiz	.295 In/Sec	.700 G-s
83 - Compressor OB Axial	.065 In/Sec	.932 G-s
2130-1 - FLASH VAP VAC PUMP-var speed	(06-Jul-20)	
	OVERALL LEVEL	1-20 KHz
11 - Motor OB HOR	.052 In/Sec	.248 G-s
12 - Motor OB VERT	.031 In/Sec	.247 G-s
21 - Motor IB HOR	.036 In/Sec	.773 G-s
22 - Motor IB VERT	.046 In/Sec	.827 G-s
23 - Motor IB AXIAL	.060 In/Sec	.317 G-s

71 - Compressor IB HOR	.058 In/Sec	.395 G-s
72 - Compressor IB VERT	.073 In/Sec	.415 G-s
81 - Compressor OB Horiz	.077 In/Sec	.330 G-s
82 - Compressor OB VERT	.086 In/Sec	.334 G-s
83 - Compressor OB Axial	.042 In/Sec	.387 G-s

236-06 - HYDRO FD PUMP N 236-06 -2FLR	(06-Jul-20)	
	OVERALL LEVEL	1-20 KHz
11 - Hydro Fd Pmp B No. Motor Top	.115 In/Sec	.073 G-s
21 - Hydro Fd Pmp B No. Motor Bottom	.060 In/Sec	.108 G-s

2130-6 - ABC SEC FILT FEED PUMP-NORTH	(06-Jul-20)	
	OVERALL LEVEL	1-20 KHz
11 - MOTOR OUTBOARD HORIZONTAL	.072 In/Sec	.179 G-s
21 - MOTOR INBOARD HORIZONTAL	.066 In/Sec	.377 G-s
23 - MOTOR INBOARD AXIAL	.062 In/Sec	.238 G-s
71 - PUMP HORIZONTAL	.177 In/Sec	1.211 G-s
72 - PUMP VERTICAL	.106 In/Sec	1.141 G-s

9001-1 - EAST OXIDIZER FEED PUMP	(06-Jul-20)	
	OVERALL LEVEL	1-20 KHz
11 - MOTOR OUTBOARD HORIZONTAL	.046 In/Sec	.178 G-s
21 - MOTOR INBOARD HORIZONTAL	.059 In/Sec	.301 G-s
23 - MOTOR INBOARD AXIAL	.063 In/Sec	.088 G-s
71 - PUMP HORIZONTAL	.163 In/Sec	.608 G-s
72 - PUMP VERTICAL	.168 In/Sec	.350 G-s

9001-2 - MIDDLE OXIDIZER FEED PUMP	(06-Jul-20)	
	OVERALL LEVEL	1-20 KHz
11 - MOTOR OUTBOARD HORIZONTAL	.029 In/Sec	.448 G-s
21 - MOTOR INBOARD HORIZONTAL	.032 In/Sec	.613 G-s
23 - MOTOR INBOARD AXIAL	.067 In/Sec	.193 G-s
71 - PUMP HORIZONTAL	.087 In/Sec	.264 G-s
72 - PUMP VERTICAL	.069 In/Sec	.145 G-s

7016-11 - WEST OXIDIZER FEED PUMP	(06-Jul-20)	
	OVERALL LEVEL	1-20 KHz
11 - MOTOR OUTBOARD HORIZONTAL	.023 In/Sec	.680 G-s
21 - MOTOR INBOARD HORIZONTAL	.031 In/Sec	.643 G-s
23 - MOTOR INBOARD AXIAL	.034 In/Sec	.255 G-s
71 - PUMP HORIZONTAL	.107 In/Sec	1.869 G-s
72 - PUMP VERTICAL	.109 In/Sec	2.251 G-s

234-01 - CHILL WATER PUMP 234-01	(06-Jul-20)	
	OVERALL LEVEL	1-20 KHz
11 - Chilled H2O Pump Motor OB Horizo	.065 In/Sec	.985 G-s
	OVERALL LEVEL	1-20 KHZ
11L - MOTOR HORZ OUTBOARD - L-FREQ	.051 In/Sec	1.170 G-s
	OVERALL LEVEL	1-20 KHz
21 - Chilled H2O Pump Motor IB Horizo	.045 In/Sec	1.021 G-s
23 - MOTOR INBOARD	.070 In/Sec	
	OVERALL LEVEL	1-20 KHZ
23L - MOTOR AXIAL INBOARD - L-FREQ	.068 In/Sec	.924 G-s
	OVERALL LEVEL	1-20 KHz
71 - Chilled H2O Pump IB Horizontal	.058 In/Sec	.136 G-s
72 - PUMP VERTICAL	.056 In/Sec	.183 G-s

C-203	- C-203 Comp	(06-Jul-20)	
		OVERALL LEVEL	1-20 KHz
11	- MOTOR OB HOR	.034 In/Sec	.937 G-s
12	- MOTOR OB VERT	.076 In/Sec	3.050 G-s
21	- MOTOR IB HOR	.047 In/Sec	1.653 G-s
22	- MOTOR IB VERT	.075 In/Sec	2.835 G-s
23	- MOTOR IB AXIAL	.019 In/Sec	.444 G-s
		OVERALL LEVEL	1-20 KHZ
71M	- COMP MALE SHAFT IB HOR	.036 In/Sec	1.245 G-s
72M	- COMP MALE SHAFT IB VERT	.040 In/Sec	1.126 G-s
73M	- COMP MALE SHAFT IB AXIAL	.059 In/Sec	2.873 G-s
81M	- COMP MALE SHAFT OB HOR	.051 In/Sec	8.062 G-s
82M	- COMP MALE SHAFT OB VERT	.076 In/Sec	3.594 G-s
71F	- COMP FEMALE SHAFT IB HOR	.046 In/Sec	2.224 G-s
72F	- COMP FEMALE SHAFT IB VERT	.069 In/Sec	1.972 G-s
73F	- COMP FEMALE SHAFT IB AXIAL	.077 In/Sec	3.844 G-s
81F	- COMP FEMALE SHAFT OB HOR	.055 In/Sec	2.967 G-s
82F	- COMP FEMALE SHAFT OB VERT	.047 In/Sec	1.446 G-s
9000-01	- D HYDROGENATOR FD PUMP- WEST	(06-Jul-20)	
		OVERALL LEVEL	1-20 KHz
11	- MOTOR OUTBOARD HORIZONTAL	.054 In/Sec	.140 G-s
21	- MOTOR INBOARD HORIZONTAL	.046 In/Sec	.287 G-s
23	- MOTOR INBOARD AXIAL	.028 In/Sec	.291 G-s
71	- PUMP HORIZONTAL	.096 In/Sec	.641 G-s
72	- PUMP VERTICAL	.077 In/Sec	.616 G-s
236-04A	- HYDROGNTOR PRECOOLER FD PUMP	(06-Jul-20)	
		OVERALL LEVEL	1-20 KHz
11	- MOTOR OUTBOARD HORIZ	.033 In/Sec	.553 G-s
21	- MOTOR INBOARD HORIZ	.068 In/Sec	.706 G-s
23	- MOTOR INBOARD AXIAL	.031 In/Sec	.328 G-s
71	- PUMP HORIXONTAL	.133 In/Sec	.273 G-s
72	- PUMP VERTICAL	.074 In/Sec	.248 G-s
C-202	- C-202 Comp	(06-Jul-20)	
		OVERALL LEVEL	1-20 KHz
11	- MOTOR OB HOR	.031 In/Sec	.574 G-s
12	- MOTOR OB VERT	.107 In/Sec	.656 G-s
21	- MOTOR IB HOR	.053 In/Sec	.152 G-s
22	- MOTOR IB VERT	.112 In/Sec	1.465 G-s
23	- MOTOR IB AXIAL	.048 In/Sec	1.355 G-s
		OVERALL LEVEL	1-20 KHZ
71M	- COMP MALE SHAFT IB HOR	.042 In/Sec	1.854 G-s
72M	- COMP MALE SHAFT IB VERT	.047 In/Sec	1.992 G-s
73M	- COMP MALE SHAFT IB AXIAL	.077 In/Sec	1.361 G-s
81M	- COMP MALE SHAFT OB HOR	.039 In/Sec	4.129 G-s
82M	- COMP MALE SHAFT OB VERT	.052 In/Sec	1.927 G-s
71F	- COMP FEMALE SHAFT IB HOR	.034 In/Sec	1.426 G-s
72F	- COMP FEMALE SHAFT IB VERT	.069 In/Sec	1.340 G-s
73F	- COMP FEMALE SHAFT IB AXIAL	.076 In/Sec	9.671 G-s
81F	- COMP FEMALE SHAFT OB HOR	.046 In/Sec	2.892 G-s
82F	- COMP FEMALE SHAFT OB VERT	.056 In/Sec	1.167 G-s
C-201	- C-201 Comp	(06-Jul-20)	
		OVERALL LEVEL	1-20 KHz
11	- MOTOR OB HOR	.098 In/Sec	.933 G-s

12	- MOTOR OB VERT	.084 In/Sec	1.710 G-s
21	- MOTOR IB HOR	.105 In/Sec	.574 G-s
22	- MOTOR IB VERT	.047 In/Sec	1.034 G-s
23	- MOTOR IB AXIAL	.062 In/Sec	.391 G-s
		OVERALL LEVEL	1-20 KHZ
71M	- COMP MALE SHAFT IB HOR	.039 In/Sec	2.007 G-s
72M	- COMP MALE SHAFT IB VERT	.043 In/Sec	1.777 G-s
73M	- COMP MALE SHAFT IB AXIAL	.080 In/Sec	1.816 G-s
81M	- COMP MALE SHAFT OB HOR	.051 In/Sec	3.505 G-s
82M	- COMP MALE SHAFT OB VERT	.047 In/Sec	2.553 G-s
71F	- COMP FEMALE SHAFT IB HOR	.052 In/Sec	2.215 G-s
72F	- COMP FEMALE SHAFT IB VERT	.044 In/Sec	.891 G-s
73F	- COMP FEMALE SHAFT IB AXIAL	.057 In/Sec	3.001 G-s
81F	- COMP FEMALE SHAFT OB HOR	.061 In/Sec	2.464 G-s
82F	- COMP FEMALE SHAFT OB VERT	.053 In/Sec	1.492 G-s

new AC	- INSTRUMENT AIR COMPRESSOR	(06-Jul-20)	
		OVERALL LEVEL	1-20 KHz
11	- MOTOR OB HOR	.176 In/Sec	1.291 G-s
12	- MOTOR OB VERT	.100 In/Sec	.623 G-s
13	- MOTOR OB AXIAL	.047 In/Sec	.542 G-s
21	- MOTOR IB HOR	.197 In/Sec	1.007 G-s
22	- MOTOR IB VERT	.094 In/Sec	1.001 G-s
23	- MOTOR IB AXIAL	.055 In/Sec	.628 G-s
		OVERALL LEVEL	1-20 KHZ
71F	- COMP FEMALE SHAFT IB HOR	.149 In/Sec	5.552 G-s
72F	- COMP FEMALE SHAFT IB VERT	.154 In/Sec	2.999 G-s
73F	- COMP FEMALE SHAFT IB AXIAL	.156 In/Sec	2.810 G-s
81F	- COMP FEMALE SHAFT OB HOR	.154 In/Sec	3.294 G-s
82F	- COMP FEMALE SHAFT OB VERT	.258 In/Sec	6.182 G-s
83F	- COMP FEMALE SHAFT OB AXIAL	.170 In/Sec	3.347 G-s
71M	- COMP MALE SHAFT IB HOR	.109 In/Sec	3.838 G-s
72M	- COMP MALE SHAFT IB VERT	.171 In/Sec	6.277 G-s
73M	- COMP MALE SHAFT IB AXIAL	.145 In/Sec	4.678 G-s
81M	- COMP MALE SHAFT OB HOR	.177 In/Sec	3.694 G-s
82M	- COMP MALE SHAFT OB VERT	.257 In/Sec	2.804 G-s
83M	- COMP MALE SHAFT OB AXIAL	.215 In/Sec	2.674 G-s

201-08A	- COMPRESSOR,NASH A 201-08A	(06-Jul-20)	
		OVERALL LEVEL	1-20 KHz
11	- Nash Compr A Motor OB Horiz	.069 In/Sec	.076 G-s
12	- Nash Compr A Motor OB Vertical	.068 In/Sec	.107 G-s
13	- Nash Compr A Motor OB Axial	.148 In/Sec	.060 G-s
21	- Nash Compr A Motor IB Horiz	.077 In/Sec	.089 G-s
22	- Nash Compr A Motor IB VERT	.093 In/Sec	.111 G-s
23	- Nash Compr A Motor IB AXIAL	.136 In/Sec	.090 G-s
71	- Nash Compr A COMP IB HORIZ	.141 In/Sec	.897 G-s
72	- Nash Compr A Compressor IB Verti	.225 In/Sec	1.346 G-s
73	- Nash Compr A COMP IB AXIAL	.146 In/Sec	.358 G-s
81	- Nash Compr A COMP OB HORIZ	.152 In/Sec	.462 G-s
82	- Nash Compr A Compressor OB Verti	.258 In/Sec	.697 G-s
83	- Nash Compr A Compressor OB Axial	.157 In/Sec	.333 G-s

9002-10	- D-HYDROGENATOR AGITATOR	(06-Jul-20)	
		OVERALL LEVEL	1-20 KHz
11	- MOTOR OUTBOARD HORIZONTAL	.081 In/Sec	.131 G-s
21	- MOTOR INBOARD HORIZONTAL	.058 In/Sec	.148 G-s

23	- MOTOR INBOARD AXIAL	.050 In/Sec	.124 G-s
31	- GEARBOX INPUT SHAFT -HORIZONTAL	.214 In/Sec	.536 G-s
51	- GEARBOX TOP PLATE- E-W	.197 In/Sec	.153 G-s
52	- GEARBOX TOP PLATE- N-S	.190 In/Sec	.343 G-s
53	- GEARBOX OUTPUT TOP -VERTICAL	.152 In/Sec	.604 G-s
61	- GEARBOX BOTTOM E-W-HORIZONTAL	.117 In/Sec	.157 G-s
81	- AGIT INTERMED BRG @ SEAL- N-S	.040 In/Sec	.023 G-s
82	- AGIT INTERMED BRG @ SEAL- E-W	.031 In/Sec	.023 G-s
83	- AGIT INTERMED BRG @ SEAL- VERT	.035 In/Sec	.126 G-s

Clarification Of Vibration Units:
Acc --> G-s PK
Vel --> In/Sec PK

Abbreviated Last Measurement Summary

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Database: Arkema.rbm
Station: HYDROGEN
Route No. 1: H2 MONTHLY
Report Date: 06-Jul-20 13:02

MEASUREMENT POINT		OVERALL LEVEL	HFD / VHFD
P2A	- PUMP MEA CIRC WEST P2A	(06-Jul-20)	
		OVERALL LEVEL	1-20 KHz
11	- West MEA Circ Pmp Mtr OB Horizon	.070 In/Sec	.134 G-s
21	- West MEA Circ Pmp Mtr IB Horizon	.054 In/Sec	.157 G-s
23	- motor inboard axial	.053 In/Sec	.228 G-s
71	- West MEA Circ Pmp Pump IB Horizo	.199 In/Sec	.665 G-s
72	- pump vertical	.138 In/Sec	.654 G-s
P1B	- PUMP BFW EAST P1B	(06-Jul-20)	
		OVERALL LEVEL	1-20 KHz
11	- East Boiler FW Pmp Mtr OB Horizo	.188 In/Sec	1.272 G-s
21	- East Boiler FW Pmp Mtr IB Horizo	.157 In/Sec	5.225 G-s
23	- motor inboard axial	.129 In/Sec	5.223 G-s
71	- Pump IB HORIZ	.197 In/Sec	.106 G-s
72	- East Boiler FW Pump IB Vertical	.137 In/Sec	.182 G-s
81	- Pump OB HORIZ	.165 In/Sec	.470 G-s
82	- East Boiler FW Pump OB Vertical	.161 In/Sec	.262 G-s
83	- East Boiler FW Pump OB Axial	.063 In/Sec	.709 G-s
C2	- FD BLOWER C2	(06-Jul-20)	
		OVERALL LEVEL	1-20 KHz
11	- F.D.Fan Motor OB Horizontal	.115 In/Sec	.356 G-s
21	- F.D.Fan Motor I Horizontal	.120 In/Sec	.765 G-s
23	- F.D.Fan Motor AXIAL INBOARD	.048 In/Sec	.319 G-s
71	- F.D.Fan Coupling End Brg Horizon	.086 In/Sec	2.062 G-s
81	- F.D.Fan Fan End Brg Horizon	.118 In/Sec	.987 G-s
C1	- ID -BLOWER C1	(06-Jul-20)	
		OVERALL LEVEL	1-20 KHz
11	- I.D.Fan Motor OB Horizontal	.131 In/Sec	.166 G-s
21	- I.D.Fan Motor IB Horizontal	.152 In/Sec	.357 G-s
23	- motor inboard axial	.183 In/Sec	.281 G-s

71 - I.D.Fan Coupling End Horizontal	.115 In/Sec	1.127 G-s
72 - I.D.Fan Coupling End VERTICAL	.093 In/Sec	1.075 G-s
81 - I.D.Fan Fan End Horizontal	.269 In/Sec	1.154 G-s
82 - I.D.Fan Fan End VERTICAL	.235 In/Sec	1.502 G-s

Clarification Of Vibration Units:

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