TECHNICAL BULLETIN

PROGRESSING CAVITY PUMPS | LS-TB-005



BULLETIN LSI-TB-005 D1 TOPIC

PCP ELASTOMER COMPATABILITY TESTING OVERVIEW

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BACKGROUND

To provide an engineered rotor/stator fit in applications where swell is anticipated Lifting Solutions conducts elastomer compatibility testing based on ASTM D471. This process exposes elastomer samples to various fluids under controlled conditions followed by measurement of changes to the elastomer including volumetric swell, mass change and various mechanical properties before and after.

STANDARD TEST METHOD

Our standard test method includes 168hr (7day) immersion testing of 2mm elastomer test specimens. Test fluids include wellbore fluids, workover chemicals and standard reference fluids at specified concentrations. Testing chambers are temperature controlled and keep the samples agitated as required to maintain adequate fluid emulsion and specimen exposure. Testing does not consider the impacts of gas as it is completed at atmospheric pressures.

TEST RESULTS (SINGLE FLUID)

Test results are recorded in a database that allows generation of a specific single fluid compatibility report containing general information about the sample collected (who, what and where) as well as information about the tests being conducted. A tabular summary documents the elastomer type and corresponding volume, mass, hardness, tensile and elongation changes. An interpretation section provides detailed commentary on the test results as well as an elastomer recommendation with a target baseline test efficiency, temperature and speed.

			GENERAL	INFORMATION				
COMPANY:	Baytex			CONTACT	War	ren Weise		
HELD;	Hoosier	5.(WELLS	C14	-19-32-26w3	8	
SAMPLE ID:	043-Bc	ytex		SAMPLE DATE:	09/0	8/2018		
WATER OUT (%):	99%			POOL ORZONE:		Provided		
APLORAVITY (?):	20			H2S CONCENTRATION	(%) Not	Provided		
EVALUATION OBJECTIVE:	To dete	ermine the eff	ect of the well fluid	on LSP's MNL and H	N1 elcstom	ers,		
			TEST IN	FORMATION				
EST SAMPLE CONFIGURA	TION:		specimens (ASTM	D471)		0		
EMPERATURE:		30 °C		DURATION:		168 hrs		
AB 1651 SEQUENCE:		MC18-0150:	0151	1EST DATE:		23/08/201	8 to 30/08/2018	
EST EQUIPMENT:		Heated stim	ng block					
ELASTOMER TYPE	Maria	IME CHANGE	MASS CHANGE	HARDNESS CHANG	IGE TENSILE CHANGE		ELONGATION CHANGE	
MEDIUM NITRILE (MIN1)	1 100	1.9%	1.5%	-1		-1.5%	3%	
SOFT NITRILE (SNT)	1				-	-(0.0	3/8	
HIGH NITRILE (HN1)			1.4%	-1	- 3	2%	4%	
OTHER	-	1.7.79	1,44,70			2/0	44/0	
the elastomerswell for the high nitille is lit/pump sizing. Me change (-1 pt) and elastomer are accord the improved mech the volume change out and lest tempe practices/equipme practices/equipme famperature of 22 ⁹	of the L sightly i chanical tensile aptable hanical a of the rature of nt and i C accord with terr	ifting Solutions ower than the al properties of from a fluid ci- properties and elastomers an anditions. No allow compar- mmodates for iperature. ew including (ANNI and HNI eld 1,935 for the media both eldstormer e- nanges of less than ampatibility issue (3 3) over cost, e in line with what 1 is lower cost, e in line with what 1 is that the less ten son to other results sight heating with somp model, press mended prelimin	stomes is character im nitile either wou spetenced minor d 2015. When as is the il recommends start would be expected sperature of 300 wo and although slight in the pump and is o wre loading and spe ary stang target for f	ized as low. Id be accepted and ages as in eages as in eages here against a more subsection for the second be a conservation for a second be a conservation be a conservation	. While the splatale with platale with indicated by aboth a me redium nitrit contect 20°A actifate star an the repo tive value sin internated to stomen is 40	dium and high nitrile e elastionner due to PI gravity, high water vaard testing rted bottomhole noe elastomer swell o finalize pump sizing, to 60% and HN1	
on the basis of thes elastomer is 45 to 6			al lift and a test spe	sed of 300 Krwi with	into startata	10 20 10 300	, IOST IIUIUI	
While a full applica on the basis of thes		at pump rate	al lift and a test spe		August 31 2		, 1651 110101	

TEST RESULTS (MULTI FLUID SUMMARY)

Single fluid summaries can also be combined to generate a multifluid summary that compares a range of completed tests. These summary reports allow for detailed cross reference of multiple tests grouped by client, API density range or another category as required.

Sample (D	Sampling Date	Sampling Location	Clent	Red	Well	Pod/Zore	API	Bottomhole Teno (-C)	Well Water Cut (%)	Well Sand Cut (%)	ISITestID	Test Completion Date	Sample Water Cut (Ext %)	Test Temp. (*C)	Ageing time (hrs)	Einstomer	Eastomer Sample Type	Hardness Change (pts)	Volame Change (%)	Mass Change (%)	Change in Tensile (%)	Change 1 Elongatio (15)
045-CNRL	Aug 18	Welhead	Don Stang	Sentac	13-32-39-26W3		13		. WHE SCHE	-	MC15-159-155	06/09/2018	10	30	168	MN1 HN1	2mm	0	16	1.3	8	13
OSE CNRL	Sept 28 2018	Wellhead	Inthrol	Alde-sen East	0011-4-15-7W4	Glauconite G	12.7	30	96	Min	MC15-18P-181	11/10/2016	20	30	168	MNI	2mm	4	3.0	2.6	10	18
SRA-CNRL	Sept 28 2018	Battery	Bright Jordan	Alderson East	16-36-14-8W4 (Battery)	hjection	3/8	Na	-1/2	2/8	MC15-184-185	18/10/2018	100	30	168	8K1 MN3	2mm 2mm	0	2.4	2.2	-1 -12	1 5
056-CNRL	Sept 28 2018	Satellite	Bright Jordan	Alde-son East	10-53-14-7W4 [Satelite]	Water Glauconite G	14.5	30	50.9	10 TO .S	MC15-191-191	24/10/2018	20	30	168	HN1 MN1	2mm 2mm	7	3.4	33.6 -0.3	-11	10
SGA CNRL		Satelite	Bright Jordan	Alderson East	10 33 14 7W4 Saterlite)	hjection	3/4	24	1/4	501 2/0	MC15 18k:189	18/10/2018	100	30	168	Bh1 MN1	2mm 2mm	-1.1	2.6	-1.8 -11.7	-17	6
		Facility	Bright Jondan		-	Water	7/8	og a		22.0				_		Hh1 MN1	2mm 2mm	7	18.8	118	-9	2
047 CNRL	Jay 11 2018	Treater	Bright Jordan	Airport	6-24-10-17W4	Sunburst			99.3		MC15-158-159	13/9/2018	99	30	168	HN1 MN3	2mm 2mm	-2	1.5	1.3	-13	5
157-CNRL	Jay 11 2018	Battery	Bright	Tide Lake	13-08-18-10W4 (Rattery)	Sover Marrille E & HGH	22.R	30	88.3	up to 1 10 2%	MC15-178-179	11/10/2018	80	30	168	HN1	2000	1	2.6	2.3	1	1
159 CNRL	Sept 28 2018	Battery	Jordan Bright	Brooks North	12 12 20 12W4 (Battery)	Manville M, EE & A	23,4	32	98.5	3	MC15 182-183	11/10/2018	10	30	168	MN1 HN1	2000	-1	3.7	2.9	412	12
46-CNRL	Jay 11 2018	Facility Treater	Jordan Bright	Warner	4-20-7-16W4	Sunburst			96.9	3	MC15-158:157	06/09/2018	25	30	168	MN1 HAT	Imm Imm	2	3.6	2.7	4	17
155-CNRL	Sept 28 2018	Battery	Jondani Bright	Relaton	5-14-18-10W4	Lover Marville W& HGH	25.6	30	86.1	up 10 1- 3%	MC15-192:193	25/10/2018	10	30	168	MN1 HN1	2/8/m 2/8/m	3	2.7	0.8	- 6	13
SSA-CNRL	Sept 28 2018	Battery	Iordan	Reiston	5-14-18-10W4	LONCY Marville W& >GP	25.6	30	86.1	10 10 L 25	MC15-189-187	18/10/2018	80	30	168	MN1 HAT	2000	7	11.1	11.4	-15	3
SSE CNRL	Sept 28 2018	(TankS) Battery	Bright Jordan	Relation	5 14 18 10W4	Parmo Water	3/8	n/a	n/a	2/8	MC15 194:195	25/10/2018	100	30	168	MN1	2 mm	-4	6.0	1.4	6	3.6
MO-CNRL	July 2018	Nat	Bright Dylan	Hallon	Not Specified		38	18			MC18-126-127	02/08/2018	50	30	168	HN1 MN1	2mm 2mm	-3	3.6	0.9	-28	-22
10	isy ana	Specified	Boachard	194400-1	no preses			- 10			NO.10.120.027	CATORY AUTO	~		100	HN1	2 mm	2	8.3	2.5	6	1
3						0	W 13	5 MNI Elector	ner III (SI.)	HNI Elec	tomer											1991.54
atomer Swell ()																						
Volume El								_				1			-						E	Modera Swell
1	16 10		10 24	12.4 11.1	2.4 2.6 14.5	13.0	1.0	1.5	2.9 2.6		3.7 1.7	3.6 2.9		53	2.7	55.5	18.3	5.9	16	5.5	1.1	Low Su

INTERPRETATION

Based on a median major/minor stator elastomer thickness, the resulting dimensional change would be around 0.005" on the majors and 0.015" on the minors (tighter) for every 1% of elastomer swell. In addition to the aromatic swell measured, the thermal component is responsible for approximately 1% swell for every 25oC of temperature increase.

Volume swell characterization and its effects on sizing:

<2%	Low	Little impact on pump sizing
2 to 5%	Moderate	Requires consideration in pump sizing
5 to 10%	High	Pump sizing challenging/normally iterative
>10%	Extreme	Application not recommended

Hardness changes:

<5%	Low	Allowable
>5%	Moderate	Requires application consideration

Tensile/Elongation changes:

<25%	Low	Allowable
>25%	Moderate	Requires application consideration

CONCLUSION

Understanding the effects of produced fluids and workover chemicals on progressing cavity pump elastomers is an important consideration in determining the optimal baseline test efficiency. Fluid compatibility testing combined with accurate rotor/stator measurements and a balanced compression fit is the key to optimized torque, efficiency and the longevity associated with a proper engineered rotor/stator fit.

