

INTRODUCTION

- **In the year 2006 the costs of using rubber compounds based on fluoroelastomer are expected to continue to be extremely competitive**
- **All rubber manufacturing processes produce waste**
- **This waste can be recycled and incorporated back into the compound with equal or better processing and performance properties**
- **Heat resistance and sealing performance are critical attributes to most applications requiring fluoroelastomer rubber compounds**
- **Long term compression set and heat aging test data are an indication of these performance characteristics**

PURPOSE OF STUDY

Evaluate long term compression set and heat aging properties of a fluoroelastomer rubber compound with increasing amounts of recycled FKM processed by

Fluoroelastomer Recycling Systems

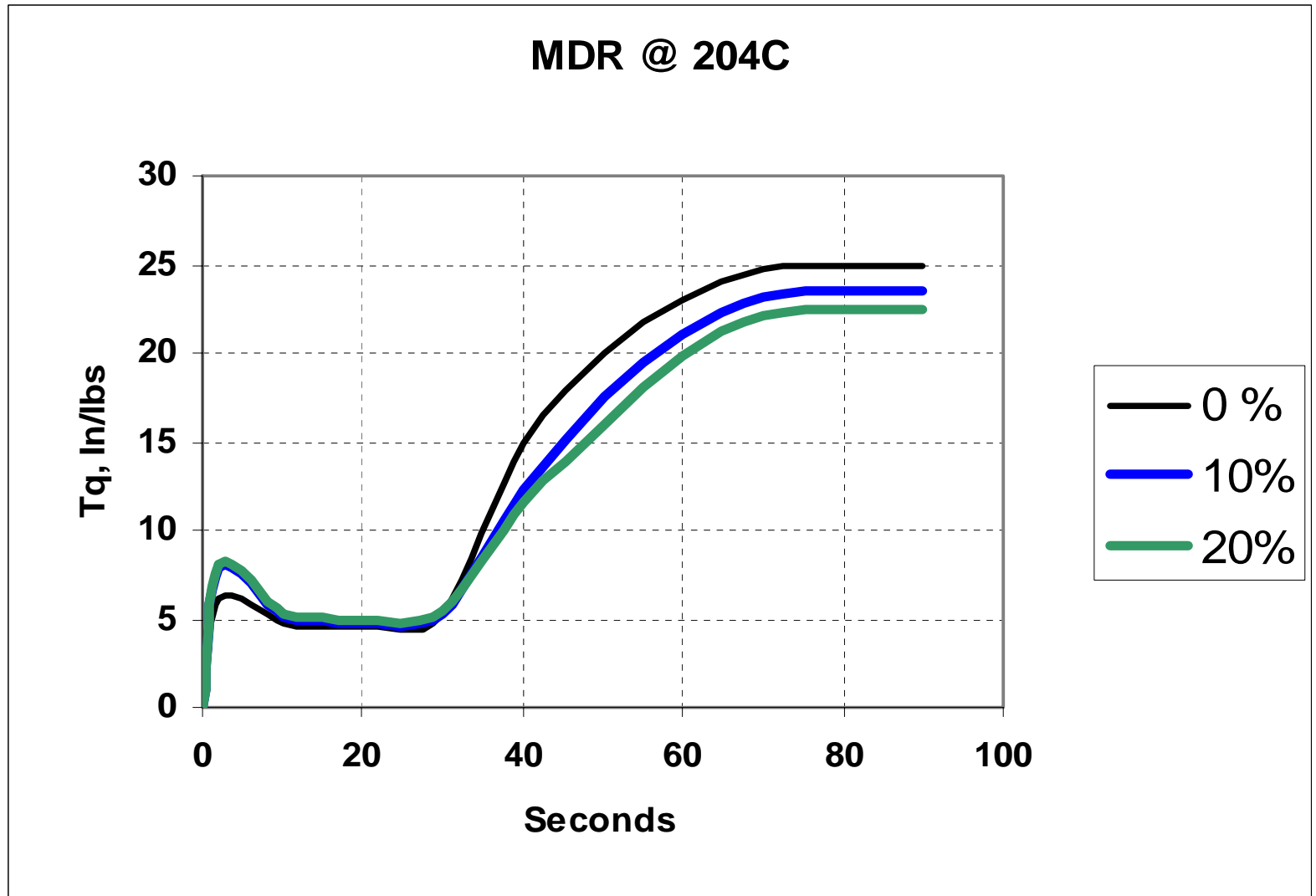
PROCEDURE

- 1. Mix and press cure ten pounds of VITON® based rubber compound shown in Slide 4.**
- 2. Recycle the cured material using the FRS process in Valley Park, Mississippi**
- 3. Remix the original compound adding 16 PHR (10%) and 35 PHR (20%) of the recycled FKM using a 13-inch laboratory mill**
- 4. Test normal durometer, stress strain, compression set and heat aging in stages up to 1008 hours (42 days) at 232 degrees C on the control and the two test compounds**

RECYCLED FLUOROELASTOMER IN AGGRESSIVE
APPLICATIONS

<u>COMPOUND TESTED</u>	
<u>INGREDIENT</u>	<u>PHR</u>
VITON A401C	100
N990	30
Calcium Hydroxide	6
Emag 170	3
Process Aide	1
FRS 170	0/16/35

RECYCLED FLUOROELASTOMER IN AGGRESSIVE APPLICATIONS



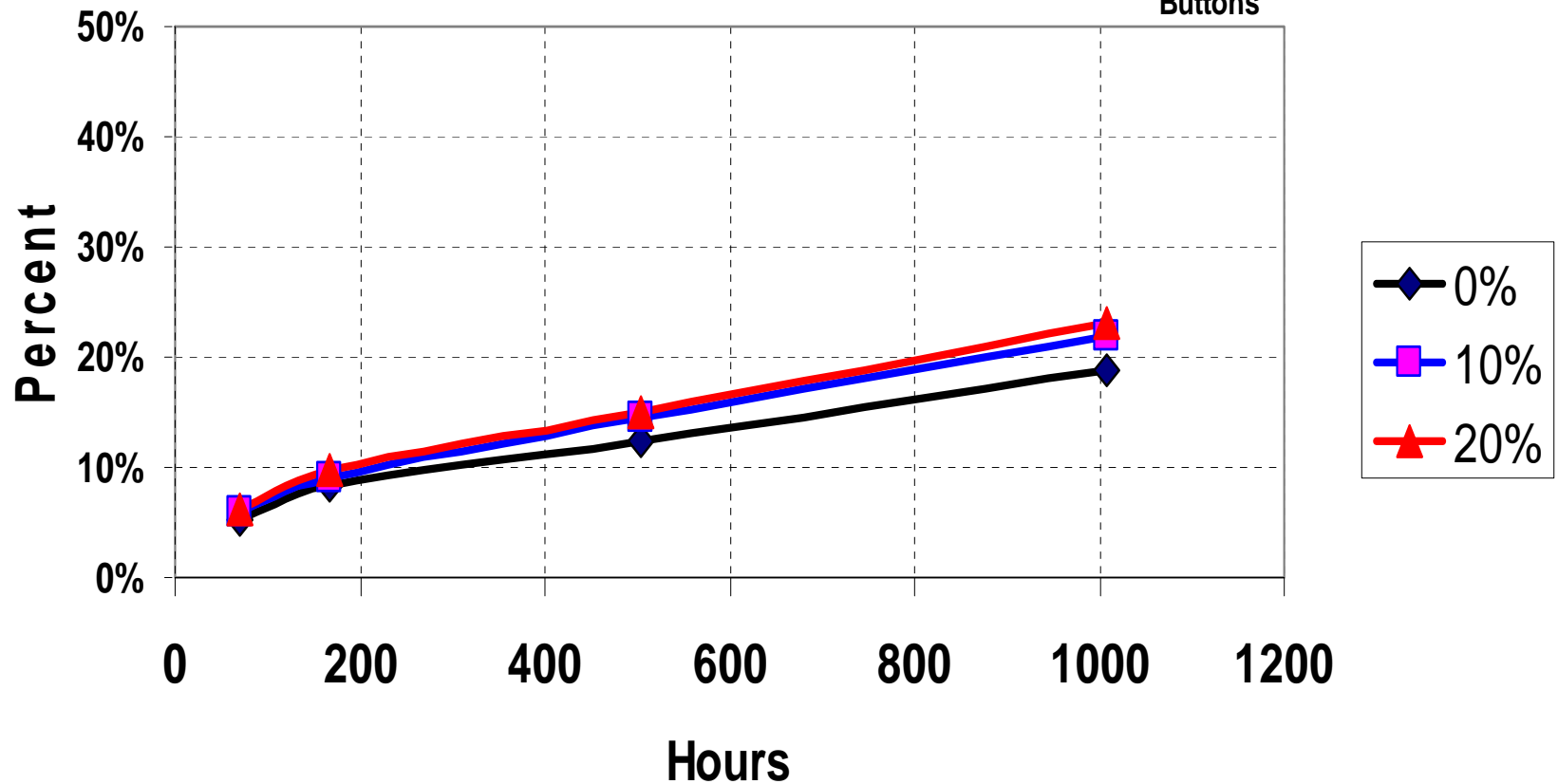
**RECYCLED FLUOROELASTOMER IN AGGRESSIVE
APPLICATIONS**

		COMPOUND TESTED			
		PHYSICAL PROPERTIES & COMPRESSION SETS			
			<u>A</u>	<u>B</u>	<u>C</u>
		PERCENT RECYLED	<u>0%</u>	<u>10%</u>	<u>20%</u>
	VITON A401C	PPH	100	100	100
	N990	PPH	30	30	30
	CaOH	PPH	6	6	6
	Emag 170	PPH	3	3	3
	Structol WS280	PPH	1	1	1
	FRS 170	PPH	<u>0</u>	<u>16</u>	<u>35</u>
	TOTAL		140	156	175
(PRESS 10m 177 deg C / OPC 16h 230 deg C)					
Original	Durometer A	SH A	77	78	80
Physical	Specific Gravity		1.844	1.841	1.843
Properties	Tensile strength	MPa	13.1	13.0	13.2
	Elongation	%	209	200	196
	100% Modulus	MPa	6.2	6.5	6.6
Compression	70 hr	%	5.3%	5.9%	6.1%
Set, buttons	168 hr	%	8.3%	9.0%	9.7%
Hrs @ 150 C	504 hr	%	12.5%	14.5%	15.1%
	1008 hr	%	18.9%	22.0%	23.0%

RECYCLED FLUOROELASTOMER IN AGGRESSIVE APPLICATIONS

Compression Set
(70 HRS @ 150C)

Buttons



**RECYCLED FLUROELASTOMER IN AGGRESSIVE
APPLICATIONS**

HEAT AGING CHANGES @ 230 deg C					
			<u>A</u>	<u>B</u>	<u>C</u>
		PERCENT RECYCLED	<u>0%</u>	<u>10%</u>	<u>20%</u>
Heat Aged	Chg in duro	points	+2	+2	+1
70 hr @ 230 C	Chg in tensile	%	+6	+8	+11
	Chg in elong.	%	-23	-25	-12
	Chg in M100	%	+26	+23	+19
	Chg in Mass	%	-0.9	-0.9	-1.0
Heat Aged	Chg in duro	points	+2	+2	+1
168 hr @ 230 C	Chg in tensile	%	+18	+2	+17
	Chg in elong.	%	-19	-25	-10
	Chg in M100	%	+33	+27	+22
	Chg in Mass	%	-1.7	-1.8	-2.0
Heat Aged	Chg in duro	points	+4	+3	+2
504 hr @ 230 C	Chg in tensile	%	+14	-3	-13
	Chg in elong.	%	-13	-17	-20
	Chg in M100	%	+23	+12	+8
	Chg in Mass	%	-4.3	-4.5	-4.7
Heat Aged	Chg in duro	points	+6	+5	+5
1008 hr @ 230 C	Chg in tensile	%	-5	-17	-12
	Chg in elong.	%	-16	-20	-14
	Chg in M100	%	+19	+8	+9
	Chg in Mass	%	-7.7	-8.1	-8.3

SUMMARY

An addition of up to 20% recycled FKM affects the normal stress strain, 1008 hour at 232 C heat aging and 1008 hour at 150C compression set properties in the following ways:

- **Normal physical properties within laboratory measurement error**
- **Slight increase (+3%) in compression set at 1008 hours at 150C**
- **Heat aged stress strain properties within laboratory measurement error**

CONCLUSIONS

This data indicates the following when cured FKM scrap is recycled using the FRS method and added back to the compound:

- 1. The recycled portion becomes part of the active polymer matrix and will not “breakdown” or “come apart” even when exposed to extreme thermal conditions**
- 2. Recycled FKM product from FRS can be an effective way to maintain competitiveness in the marketplace**