ARDL

AKRON RUBBER DEVELOPMENT LABORATORY, INC.

EST. 1962

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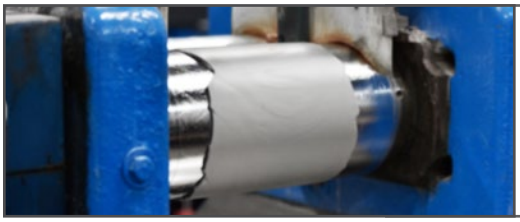
RESHORING SOLUTIONS FOR STRONGER MANUFACTURING

Let's Rebuild American Manufacturing — Together.

ARDL helps America re-shore smarter, one compound at a time.
Whether you're replacing offshore rubber components or launching a new U.S.-made product, we're your independent innovation partner.



WHAT IS IN YOUR COMPOUND?

- ARDL can tell you exactly what is in your compound - And help you **build it better, here at home.**

As U.S. manufacturers localize supply chains to improve resilience, reduce risk, and ensure quality, ARDL stands ready to help. Our independent testing and consulting services empower companies to:

- **Understanding your offshore materials** - ARDL will work with your team to understand your application's critical requirements (CTQs), guided by decades of polymer testing and application experience.
- **Analyzing imported products** - Using a full suite of analytical tools, physical testing, instruments, or engineering services, we can generate the baseline for your current producer.
- **Recreate & Enhance for domestic production** - Together, we develop a U.S.-made equivalent or improved formulation, tailored for local sourcing and superior performance.

WHAT ARDL OFFERS

- Compound reverse engineering
- Compound finger printing
- Testing to ASTM, ISO, EN & other rubber or plastic specification
- FDA compliance testing
- Functional evaluation of current product
- Application & technical consulting
- Compound development
- Prototyping
- Technical audits of manufacturing facilities
- Engineering services
- Failure analysis
- Processing Optimization
- Thermal Analysis (TGA, DSC, DMA, TMA)
- Regulatory screening for FDA, Customs, etc.

WHY CHOOSE ARDL

- Localized reverse engineering of offshore materials
- Decades of application-specific consulting
- Transparent, independent analysis—no manufacturer bias
- Rapid, confidential support for innovation or equivalency
- Support for failure analysis, litigation, and competitive benchmarking
- Compliance assistance for domestic sourcing, FDA, & Customs

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ARDL.com 866-778-ARDL CONNECT:

ISO 17025 ACCREDITED LABORATORY ISO 17025

ISO 13485 MEDICAL DEVICES ISO 13485

ISO 9001 QUALITY MANAGEMENT ISO 9001

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HOW ARDL SUPPORTS RESHORING YOUR PRODUCT *BACK* TO THE U.S.

1 - FUNCTIONAL CHARACTERIZATION

- Evaluate Offshore Product
- Focus on Critical Properties (i.e. Compression, Immersion, Tensile, etc.)

2 - REVERSE ENGINEERING

- Determine Theoretical Formulas
- Analyze Offshore Compound

3 - FORMULA VALIDATION

- Convert Theoretical Formula to a Practical One by Using U.S. Based Raw Materials

4 - RE-EVALUATION OF NEW FORMULA

- Validate Practical Formula Against the Original Functional Properties
- Optimize & Improve Formula

SCALE UP TO AN OPTIMIZED, U.S.-READY MANUFACTURING PROCESS

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Example: Typical Rubber Compound Analysis & Carbon Black Typing

COMPOUND ANALYSIS

Date:	January 10, 2022
Attention:	Ms. Mary Ann Jones
Address:	XYZ Corporation

Sample ID:	Competitor's Rubber
Sample Color:	Black
Project No.:	123456

A	**Polymer Identification** (Infrared Spectroscopy)	**Percent of RHC**
1	Polyisoprene Rubber	80
2	Styrene-Butadiene Rubber	20
B	**Ash Content**	9.8%
C	**Semi-Quantitative Ash Analysis** (ICP Mass Spectroscopy and EDX)	
a	>10%	Si
b	5-25%	Zn
c	1-10%	
d	0.5-5%	
e	0.1-1%	CA
f	0.05-0.5%	
g	0.01-0.1%	Mg, Al
h	Below Detection	Bi, P, Ti, Mn, Sn, Na, Fe, Ni, Cu, Se, Sb, Ba, Pb
D	**Total Hydrocarbon**	55.5%
E	**Total Sulfur, Leco Method**	1.60%
F	**Density**	1.193 Mg/m^3
G	**Wax Content**	Present

H	**Extractables** Solvent Extractables, %	8.1%
1	Color	Amber
2	Consistency	Semi-Solid
I	**Carbon Black**	25.0%
1	ASTM Series Black	N300
J	**Extract Analysis**	
1	**Plasticizers**	
a	Hydrocarbon Oil	
b		
c		
2	**Antioxidants**	
a	Santoflex 6PPD	
b		
c		
3	**Accelerators (Suggested)**	
a	Sulfenamide (TBBS)	
b	Santogard PVI	
c		
K	**Beilstein, Presence of Halogens**	Negative
L	**Microhardness IRHD**	61

General information provided by a reverse engineering analysis:

- Accelerators - Qualitative Only
- Antioxidant Identification
- Carbon Black Content
- Halogen Presence
- Percent Total Extract
- Plasticizer Identification
- Rubber Hydrocarbon Content
- Polymer/Polymer Blend Identification
- Filler Types and Percents
- Specific Gravity
- Theoretical Formula Reconstruction
- Total Sulfur Content
- Wax Content
- Hardness

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Example: Reconstructed Formulation

INGREDIENT	PHR	EXTRACT.	ASH	VOLUME
Polyisoprene Rubber	80.0	0.8		86.0
Styrene-Butadiene Rubber	20.0	0.2		21.3
Carbon Black (N300 Series)	44.8			24.9
Silicon Dioxide	15.2		14.6	7.6
Zinc Oxide	3.0		3.0	0.5
Hydrocarbon Oil	7.2	7.2		8.0
Stearic Acid	1.0	1.0		1.1
Santoflex 6PPD	2.5	2.5		2.5
Hydrocarbon Wax (C19-C37)	2.0	2.0		2.3
Misc. Extractables*	0.5	0.5		0.6
Sulfenamide (TBBS)	1.0	0.3		0.7
Santogard PVI	0.3	0.1		0.2
Sulfur	1.9			0.9
TOTALS	**179.4**	**14.6**	**17.6**	**156.6**

Calculated Ash Content	9.8%
Calculated Extractables	8.1%
Calculated Carbon Black	25.0%
Calculated Density (Mg/m³)	1.145

*Comments: It may contain rosin acids, accelerator fragments and other reaction products, etc.

Note: Reconstructed formulation is based on analytical data from your sample. The above calculated percentages are based on the reconstructed formulation.

To further enhance and more exactly match an unknown material, the following tests can also be performed:

- Acrylonitrile Content
- Antioxidant/Antiozonant Quantification
- Carbon Black Typing
- Free Sulfur Content
- Fiber Identification
- Halogen Content Analysis
- Pyrolysis GC/MS
- Resin Identification
- Thermal Analysis (DSC, DMA, TMA and TGA)
- Formula Compliance
- Regulatory Screening
- Quality Control
- Failure Analysis
- Off-Gassing

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Sample Submittal Form

SAMPLE SUBMITTAL/ TESTING REQUEST FORM

AKRON RUBBER DEVELOPMENT LABORATORY, INC.

Date: ____/____/____

Shipping Method: ☐ Fed Ex ☐ UPS ☐ DHL ☐ USPS ☐ Hand Deliver ☐ Other_____

Attention:

☐ Chemical Testing ☐ Microscopy
☐ Engineering ☐ Mixing/Molding
☐ Latex ☐ Physical Testing
☐ Legal/Forensics ☐ Plastics Testing

Contact Name *(if known)*:_____

Please ship samples to:
2887 Gilchrist Rd.
Akron, OH 44305
(Main Laboratory - Send samples to this address unless you are instructed to send them to the address below)
or
75 Robinson Ave.
Barberton, OH 44203

PLEASE NOTE — DOMESTIC ORDERS (US & CANADA): ***PURCHASE ORDER IS REQUIRED TO BEGIN TESTING.***
OUTSIDE OF THE US & CANADA: ***ADVANCED PAYMENT IS REQUIRED TO BEGIN TESTING.***
PLEASE CONTACT 330-434-6665 OR WORLDWIDE 330-794-6600 FOR INFORMATION ON ACCEPTED METHODS.

Name		Title	
Company			**PO# *(Required)***
Address			
City	State	Zip Code	Country
Billing Address *(If Different From Above)*			
City	State	Zip Code	Country
Phone		Fax	
Email Address			
Sample Description			
Test Required and/or Description of Problem (Briefly State Reason)			

PLEASE USE THIS FORM TO SUBMIT YOUR SAMPLES AND/OR REQUESTS FOR TESTING

2887 Gilchrist Rd. • Akron, Ohio 44305 • answers@ardl.com
Toll Free (866) 778-ARDL • Worldwide 330-794-6600 • Fax (330) 794-6610