FUNCTIONAL PRODUCTS INC.

A Solution Company

Primer on Tackifiers

Functional Products Inc.

www.functionalproducts.com

OUTLINE

- Definition
- Composition
- Uses
- Selection


THE

- Definition--

  An additive that imparts tack or stringiness to a lubricant. It may be used to provide adherence in way oils and chain lubricants, stringiness in greases, and anti-misting metalworking fluids.

- Makes an oil Viscoelastic
  - What is Viscoelastic?
    - **Viscous <u>and</u> Elastic**
    - **Stretch it -- It pulls back.**
  - Cohesive
    - **Makes oil harder to remove**

Tackiness vs Stringiness

- Tackiness <--> Adhesion
  - Difficult to demonstrate or measure
- Stringiness <--> Cohesion
  - Easier to demonstrate and measure

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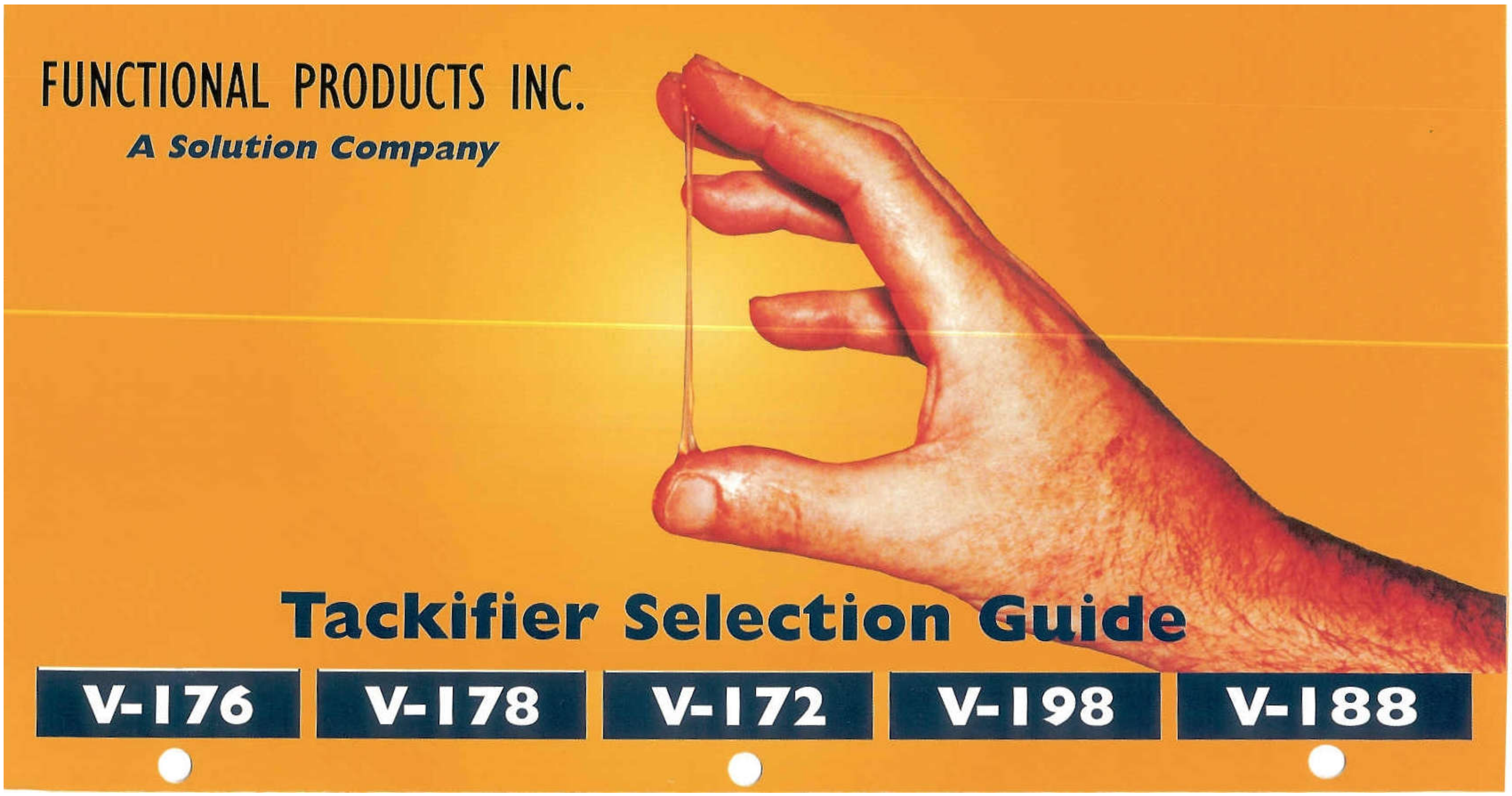

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“Ductless Siphon”

Composition—

Consists of a high molecular weight polymer, usually polyisobutylene (PIB), dissolved in an appropriate diluent, usually mineral oil.

COMPOSITION

- Polymer types
  - Polyisobutylene (1MM to 4MM Mol. Wt.)
  - Ethylene Copolymers (< 1 MM Mol. Wt.)
  - Other Hydrocarbon Polymers

Polymer Comparison

- PIB

$-[C(CH_3)-CH_2]_n$

Molecular Weight--
1 MM to 4 MM

More tack, less shear stable

Tack increases with increase in MW, shear stability decreases

- OCP

polyethylene $-[CH_2-CH_2]_n-$
Polypropylene$[CH(CH_3)-CH_2]_n-$

Molecular Weight-- 800M

More shear stable, less tacky

COMPOSITION

- DILUENTS
  - Petroleum Oils (Grp I, II, III & naphthenic)
  - White Oil
  - Vegetable Oil

FUNCTIONS

- Discourage Removal
  - Way Lubricants
- Discourage Dripping
  - Chain Lubricants
- Discourage Flinging
  - Chain Saw Oils
- Change Texture
  - Grease

PROPERTIES

- Viscoelastic Liquid
  - Can be very viscous, 3-10,000 cst @ 100 C
  - Cutbacks available for easier handling

OTHER VISCOUS ADDITIVES

- Viscosity Index Improver
  - Lower molecular weight (~150,000)
  - Provide higher viscosity but not viscoelasticity
  - Typically olefin copolymer
- Antimisting Additives
  - Intermediate molecular weight (~700,000)
  - Discourage misting
  - Minimal contribution to tackiness

Applications

- Chain Saw (Bar and Chain) Oil
  - Keeps oil from flinging from chain
  - Mid to high molecular weight PIB
- Way Lubricants
  - Keeps ways wet with oil.
  - Minimizes washing off by coolant
  - Low to mid molecular weight PIB

APPLICATIONS

- GREASE
  - Shear stability
  - Texture
  - Water resistance
  - Olefin copolymers

Special Applications

- Food-processing machine lubricants (H-1)
  - Grease
    - Helps keep grease in bearings
    - OCP in food grade oil
  - Chain Oil
    - Minimizes dripping
    - PIB in food grade oil

Antimisting Additives

- Related to Tackifiers, but lower Mol. Wt.
  - For petroleum oil systems
  - For vegetable oil systems
  - For water-based systems
- Better shear stability than Tackifiers
- Less “drag out” than with Tackifiers

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TACKIFIERS IN HIGH TEMPERATURE SYSTEMS

Problem

- A grease made from a Group 3 oil was showing poorer oxidation results than expected.
- The oxidative performance could be restored by omitting the tackifier additive

‘ CEILING TEMPERATURE’

- Polymers whose polymerization is a reversible reaction
  - 1,1-disubstituted olefins ($CH_2 = CR_2$)
    - Polyisobutylene
    - Methacrylates
- Polymer equilibrates with monomer.
- Maximum temperature polymer can exist

POLYISOBUTYLENE CEILING TEMPERATURE

- PIB → isobutylene monomer
- PIB reported unstable over ~90°C in oil
- Ceiling temperature 170 – 200°C based on thermodynamic data

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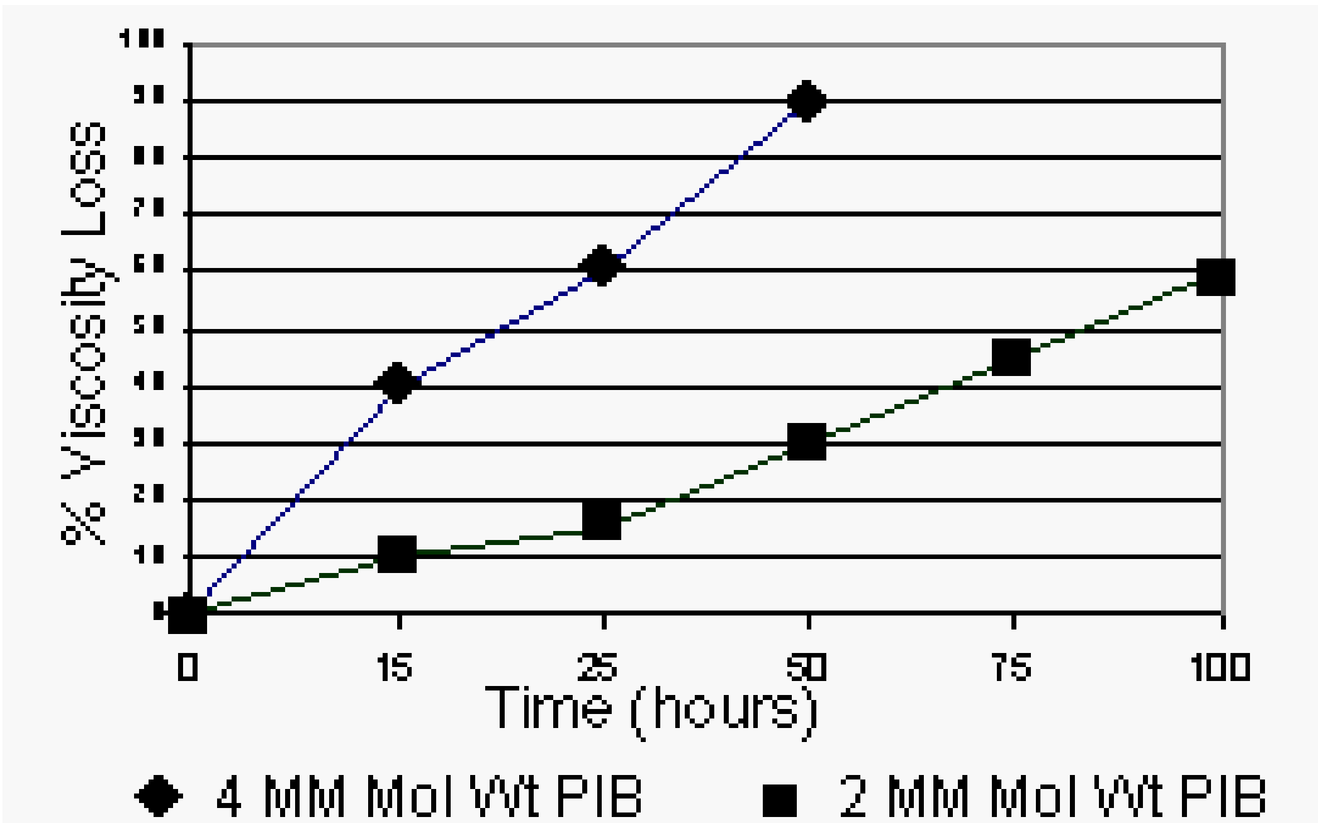
PIB in Group I oil at 100^{o}C



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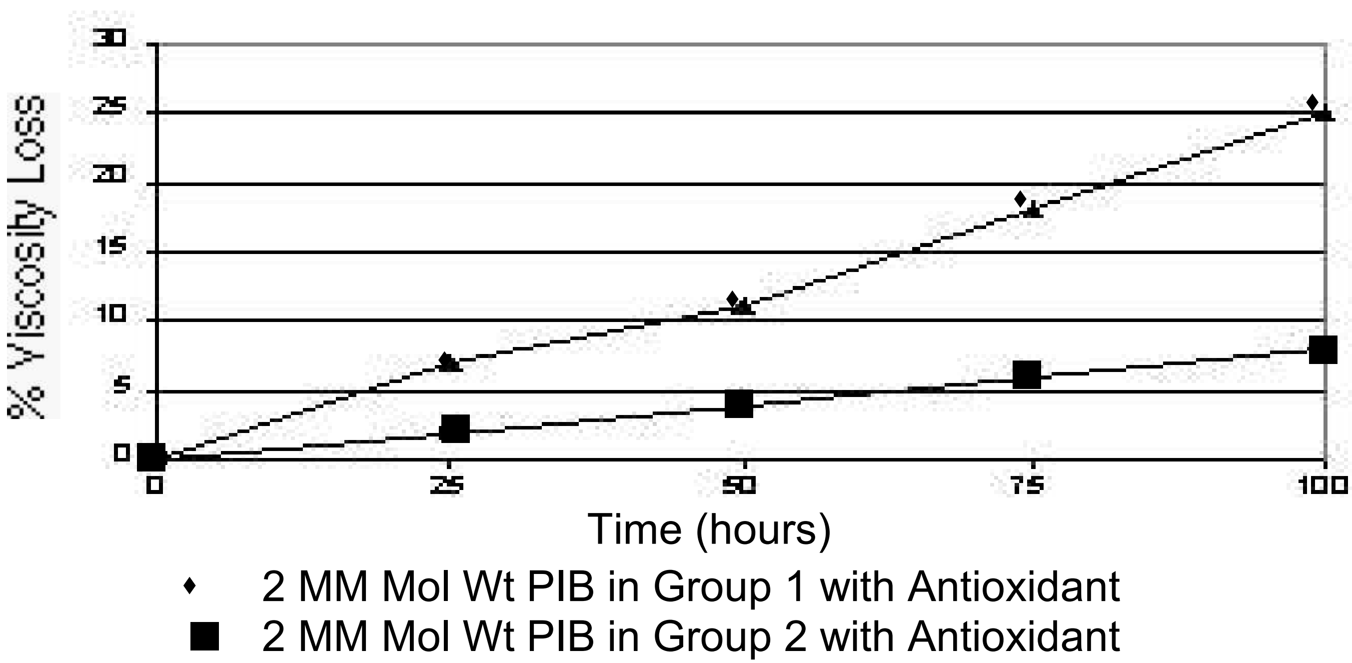
GRP I vs GRP II



Oxidative vs. Thermal Loss

- Temperature << ceiling temperature
- Rate is dependent on diluent
- Reaction inhibited by antioxidant
- Therefore
  - Polymer loss is oxidative rather than thermal
  - Viscosity loss due to polymer loss may be used to monitor the degree of oxidation

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EFFECT OF GRP I

Tackifier	2MM PIB in GRP III
Base Oil	GRP III
Treat Level	0.5%
Temperature	120 C

	% viscosity loss		
Amt GRP I (%)	0 hr	24 hr	48hr
0	0	1	1
5	0	26	49
10	0	22	42

HI TEMP EFFECT ON VISCOSITY

Polymer		2MM PIB	
Diluent		GRP I	GRPIII
AO		0.1%	0.1%
Time (hrs)	Temp (C)	Vis Loss (%)	Vis Loss (%)
96	100	37	0.0
96	120	33	0.1
72	150	97	0.1

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HIGH TEMP EFFECT ON TACKINESS

Polymer	2 MM PIB	
Diluent (tackifier)	GRP I	GRP III
Base Oil	GRP III	GRP III
Treat	0.5%	0.5%

Time (hrs)	Temp (C)	Tack Loss (%)	Tack Loss (%)
96	100	31	0
96	120	83	8
72	150	100	8

CONCLUSIONS

- Polymer breakdown is an effective way to monitor lubricant oxidation.
- The breakdown of PIB in lubricants is oxidative rather than thermal.
- Polyisobutylene in lubricants is stable to much higher temperatures than previously reported, approaching its ceiling temperature of about 170-200^{o}C, rather than merely about 100^{o}C.

CONCLUSIONS

- Relatively small amounts of Group 1 oil, quantities that may be introduced as additive diluents, are sufficient to reduce the oxidative performance of Group 3 oils or PAO's to the Group 1 level.

- Polymeric additives can be tailored for high-temperature performance by manufacture using a Group 3 diluent oil.