



► Advantages to Use Polyisobutylene in Lubricants and Greases

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Braskem

► Petrochemical Industry

“Competitive Integration Braskem”



EXTRACTION
Basic feedstocks



1st GENERATION
Basic
Petrochemicals



2nd GENERATION
Thermoplastics
Resins



3rd GENERATION
Plastics Processors

NAPHTHA
GAS
ETHANOL
SALT

ETHYLENE
PROPYLENE
CHLORINE/ SODA

AROMATICS
FUELS
SOLVENTS
SPECIALTY CHEM

PE
PP
PVC

► Braskem in numbers

Braskem operates in more than 70 countries worldwide, establishing itself as an important global player in the thermoplastics resins and chemicals market.

8.000
MEMBERS



CLIENTS
In more than:

70
COUNTRIES

GROSS
Revenue:

R\$ 54^{BI}
(US\$ 16.3 BI)

NET
Revenue:

R\$ 47^{BI}
(US\$ 14.3 BI)

EBITDA:

R\$ 9.4^{BI}
(US\$ 2.8 BI)

INTL. MKTS
Revenue:

US\$ 7.2^{BI}

INDUSTRIAL
Units:

40

INVESTMENT
Innovation
& technology

R\$ 280^{MI}
(US\$ 85 MI)

Source: Braskem Annual Report 2015.

Basic Petrochemicals

OLEFINS
AROMATICS
FUELS
SOLVENTS
SPECIALTIES

Polymers

PE
PP
Green PE
EVA
SODA
PVC

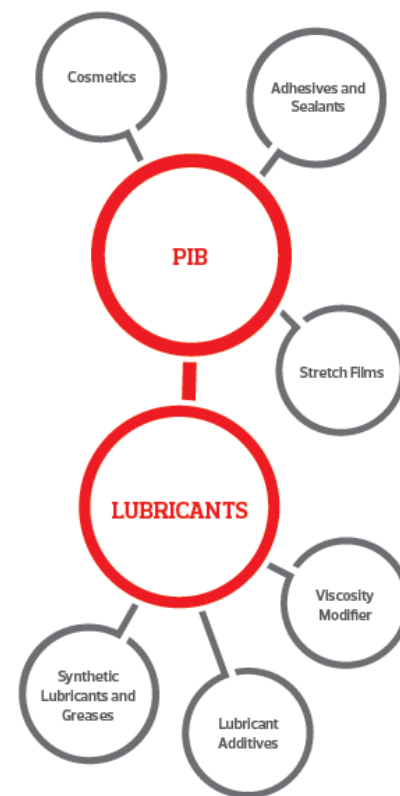


C4

► SPECIALTY CHEMICALS

PIB

A highly versatile product, present in several applications such as lubricants, stretch film, adhesives, sealants, among others, providing important technical properties.



Braskem

► **SPECIALTY
CHEMICALS**

C4

PIB

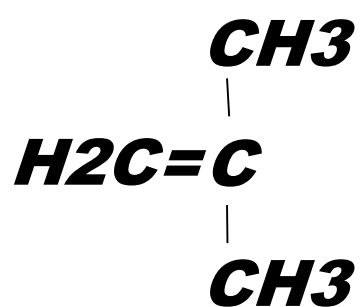
Braskem's PIB is nontoxic, meet the requirements for applications in cosmetics and food and it has NSF certification.



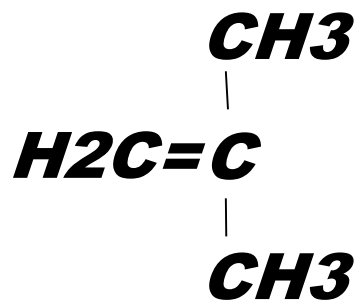
► PIB - POLYISOBUTYLENE

- Simple molecule – polymerization of isobutene under a catalyst system, in a continuous process
- One double bond per molecule – controlled reactivity
- Molecular Weight (Mn) from 300 to 4,200 g/mol
 - Kinematic Viscosity @ 37.8°C from 15 to 190,000 +
 - " @ 100°C from 6 to 13,000
- Classified as a synthetic Oil – Group V (API)

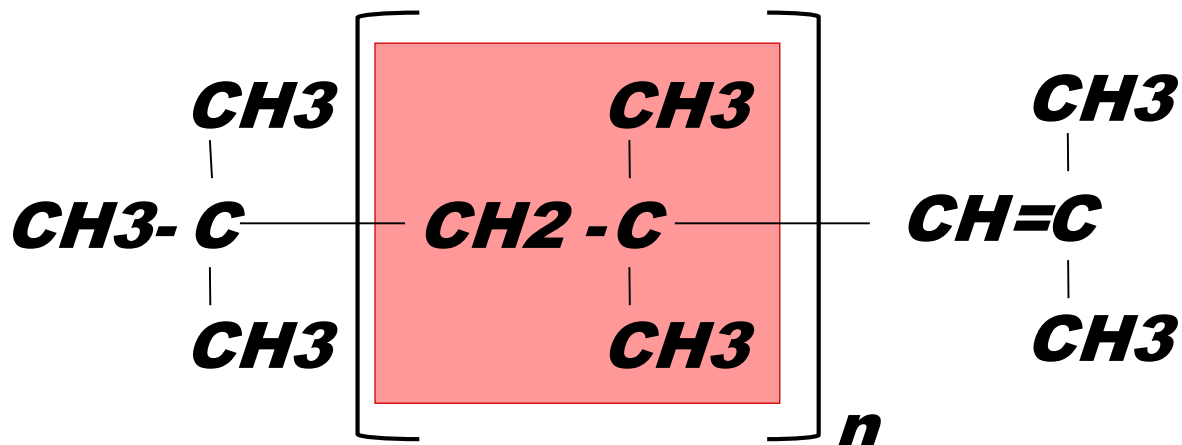
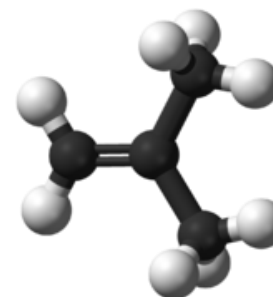
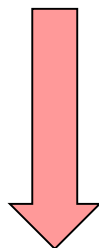
► PIB - POLYISOBUTYLENE



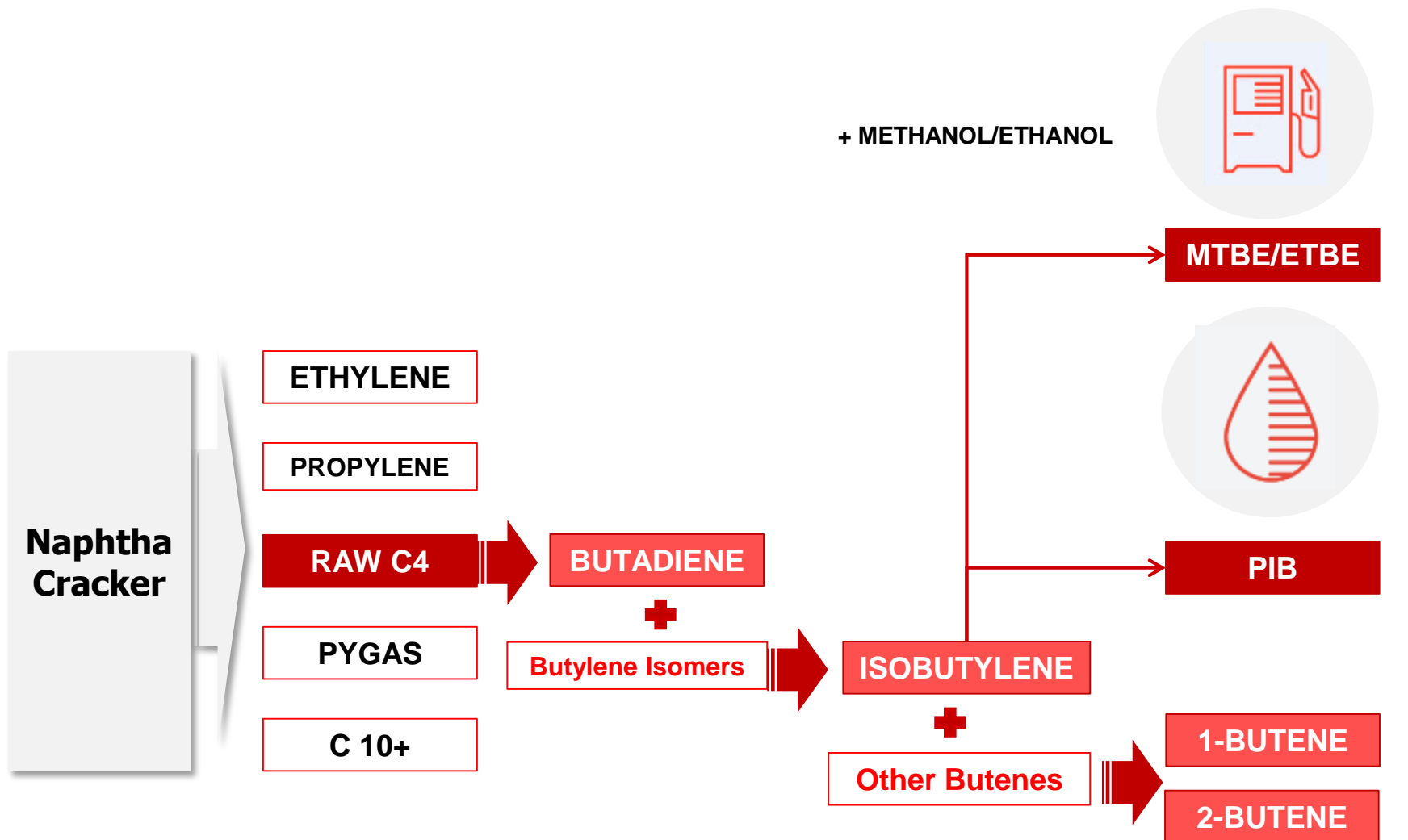
+



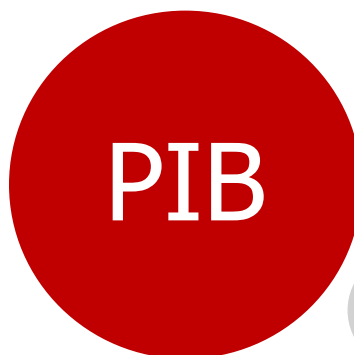
catalyst



► PIB - POLYISOBUTYLENE



► PIB - POLYISOBUTYLENE



Liquid

Bright

Clear

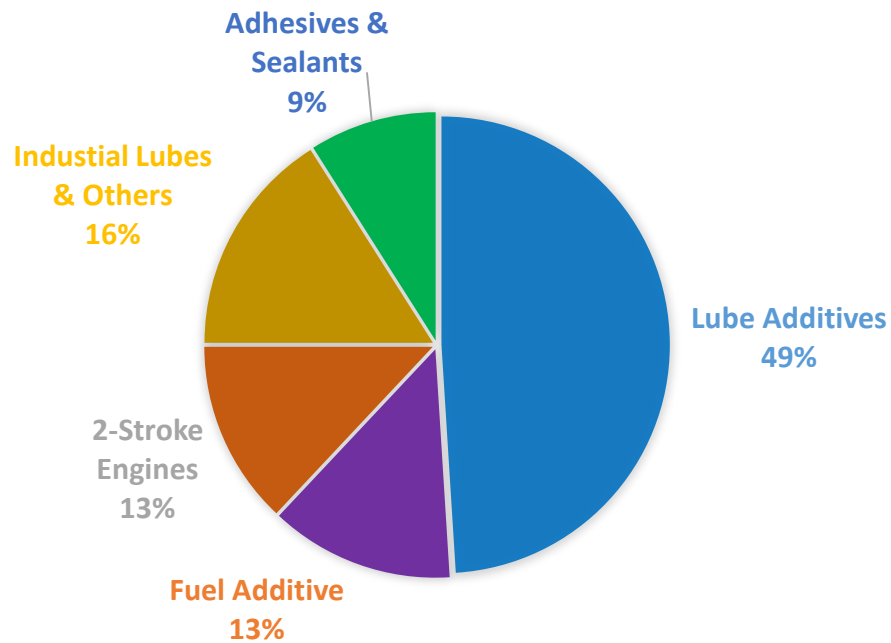
Chemically Stable

Oxidation resistant to light and temperature

Great Dielectric Properties

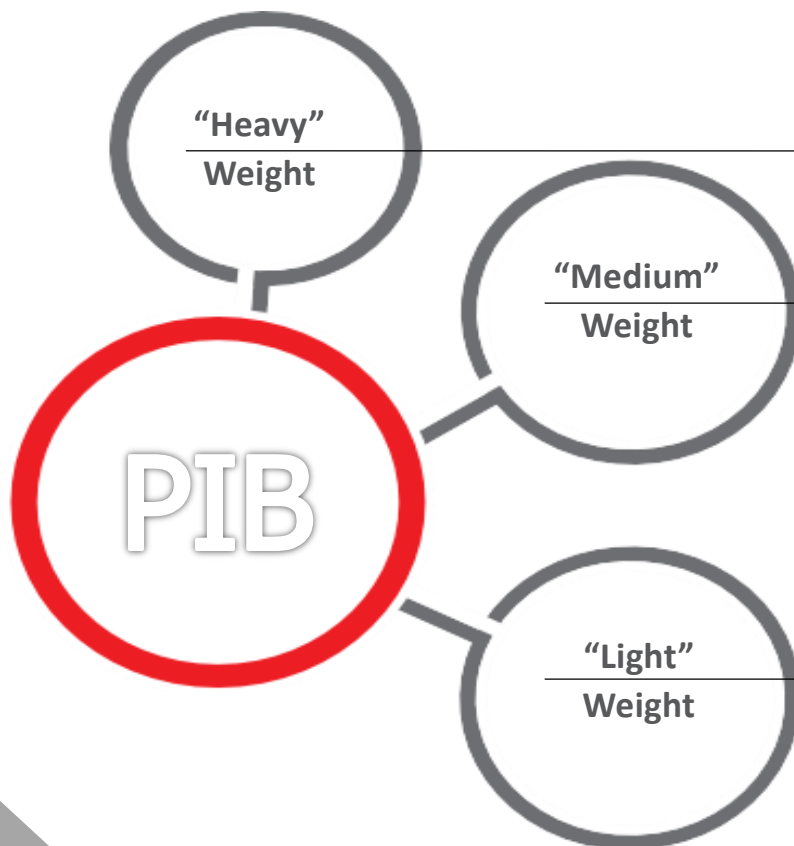
► PIB - POLYISOBUTYLENE

Applications



Global Demand ~ 900 kty

► PIB - POLYISOBUTYLENE

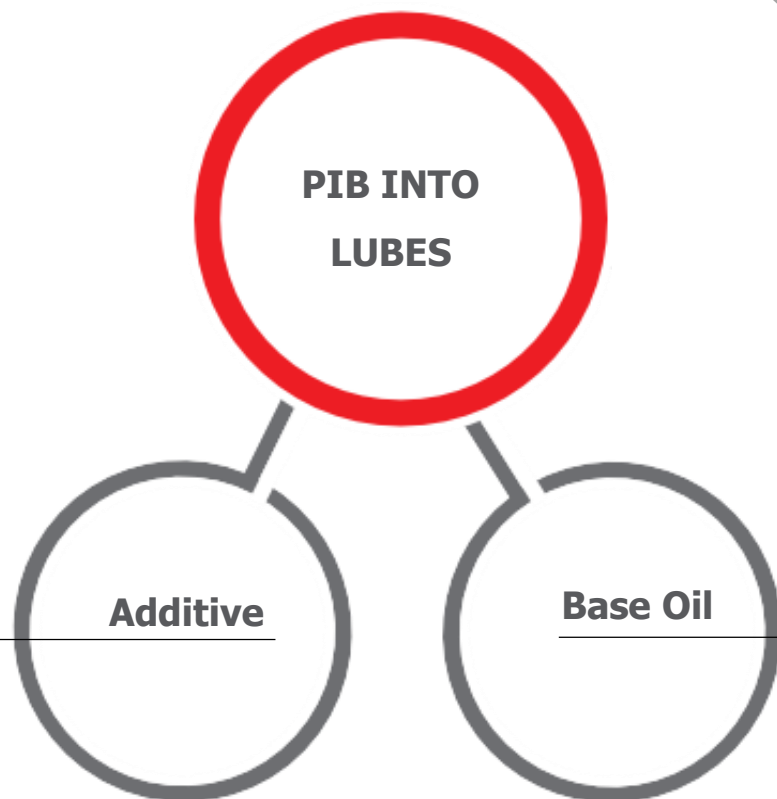


PIB	Avg Molecular Weight (g/mol)	KV @ 40°C (cSt)
240	4,200	*
128	2,700	190,000
122	2,500	120,000

PIB	Avg Molecular Weight (g/mol)	KV @ 40°C (cSt)
32	1,300	22,000
28	1,050	10,000
24	940	7,000

PIB	Avg Molecular Weight (g/mol)	KV @ 40°C (cSt)
16	640	760
10	500	380
8	440	105
6	330	32
4	300	15

► PIB - POLYISOBUTYLENE



- Surfactant
- Detergent
- Emulsifier
- Adhesion promoter
- Viscosity Modifier

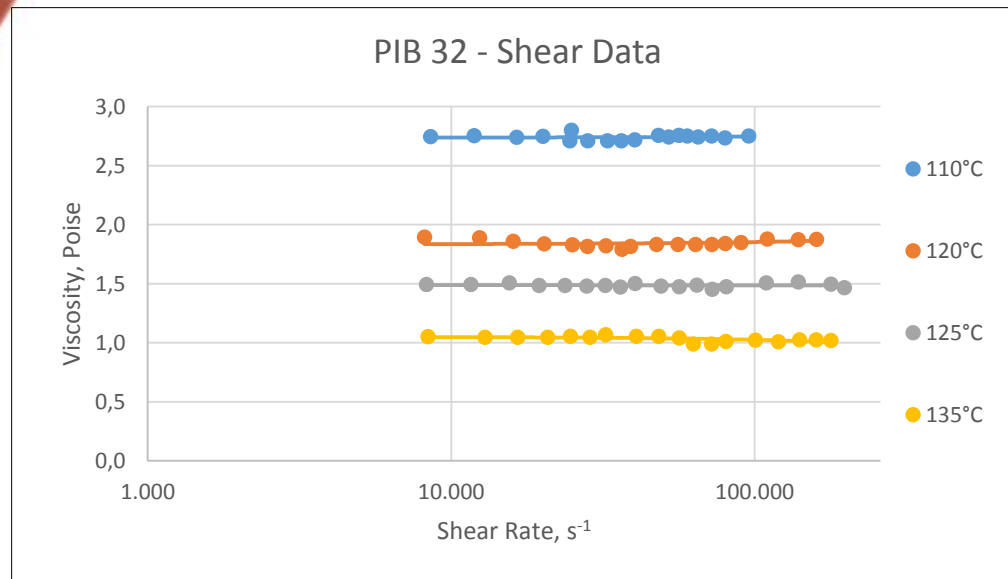
- Highly Viscous
- Shear Stable
- High Purity
- Clean Burning

► PIB as BASE OIL

Shear Stable

Sonic Shear Stability Test

Material	Initial Viscosity @ 38°C (cSt)	Decrease in Viscosity	
		1 hour	2 hours
14% PIB 122 in a 5W Oil	62,9	6%	7%
100% PIB 6	23	1,5%	2%



► PIB as BASE OIL

High Purity

- Applied in compressors and pumps in refinery and chemical processes
 - prevention of catalyst poisoning
 - High viscosity allows for handling wet gas
- Plain Rolling Bearings
 - e.g. Sugar Mill Crushing Station
 - (KV – 16,000 cSt @ 40°C)





► PIB as BASE OIL

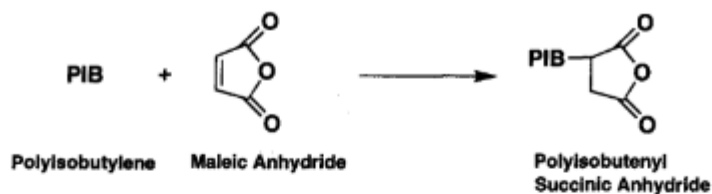
Clean burning

- Two-Stroke Engines
 - No deposits, less smoke
- Metalworking: Stamping, pressing, foiling

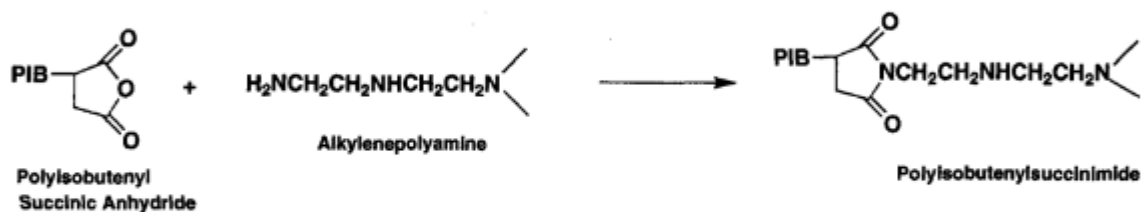
PIBSA

- PIBSA is the basis for detergents and dispersants

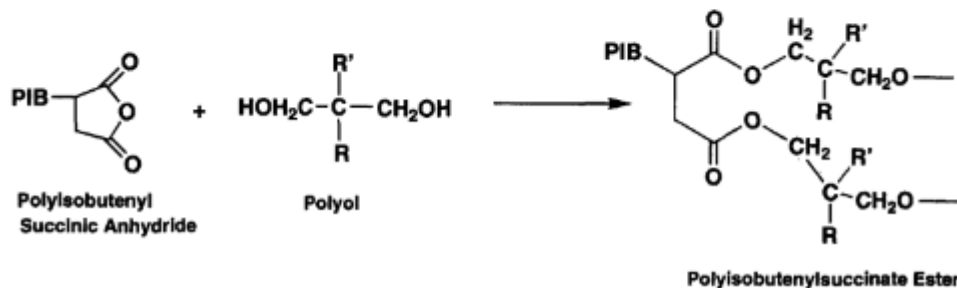
Approx. half of all PIB produced is used here



PIB + Maleic Anhydride →
Succinic Anhydride



Succinic Anhydride + Amines →
Succinamides



Succinic Anhydride + Alcohols →
Succinate Esters

PIBSA

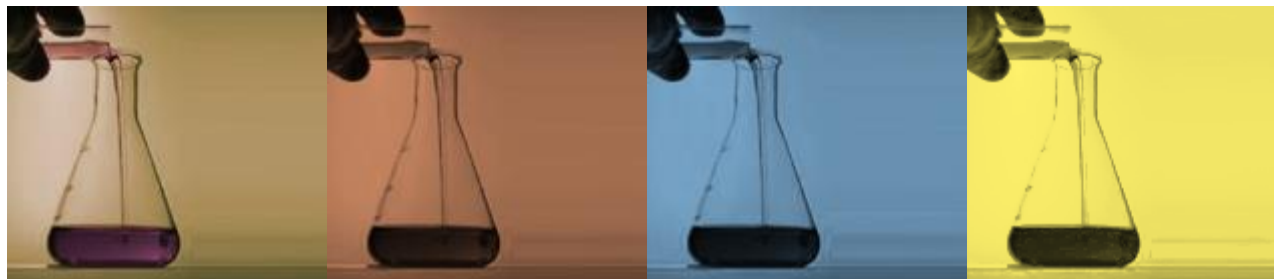
- **PIBSA is the basis for detergents and dispersants**

Approx. half of all PIB demand

Additive	Typical Lubricant Additive Package	Typical Fuel Additive Package
PIB-based ash-free dispersion agent	30-60%	89%
Detergent	15-20%	-
Anti-wear Compound (e.g. zinc dithiophosphate)	8-12%	-
Pour point depressant	10%	-
VI Modifier	5%	-
Antioxidant	10-20%	10%
Other	1-5% (e.g. corrosion inhibitor and friction additive)	1% (e.g. foam inhibitor, marker)
% of total weight	10%	0,02 – 0,025%

VI Modifiers and/or Viscosity Improvers

Grade	Viscosity Index
PIB 10	111
PIB 24	130
PIB 32	182
PIB 122	256
PIB 128	287
PIB 240	326*





PIB

In grease formulations

Used in the manufacture of specialty greases with metal soaps: calcium, aluminum and lithium stearates

Advantages brought by PIBs in the formulation

- Colorless
- Highly adhesive to the substrate
- Water and Shear resistant
- Temperature resistant
- Dielectric properties
- Broad Viscosity Range

► PIB

TECHNICAL ADVANTAGES

- Thermal and UV resistance
- Non Staining
- Hydro Repellent
- Non toxic
- Flexibility in Formulation



Thank You!

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August, 2016

Braskem