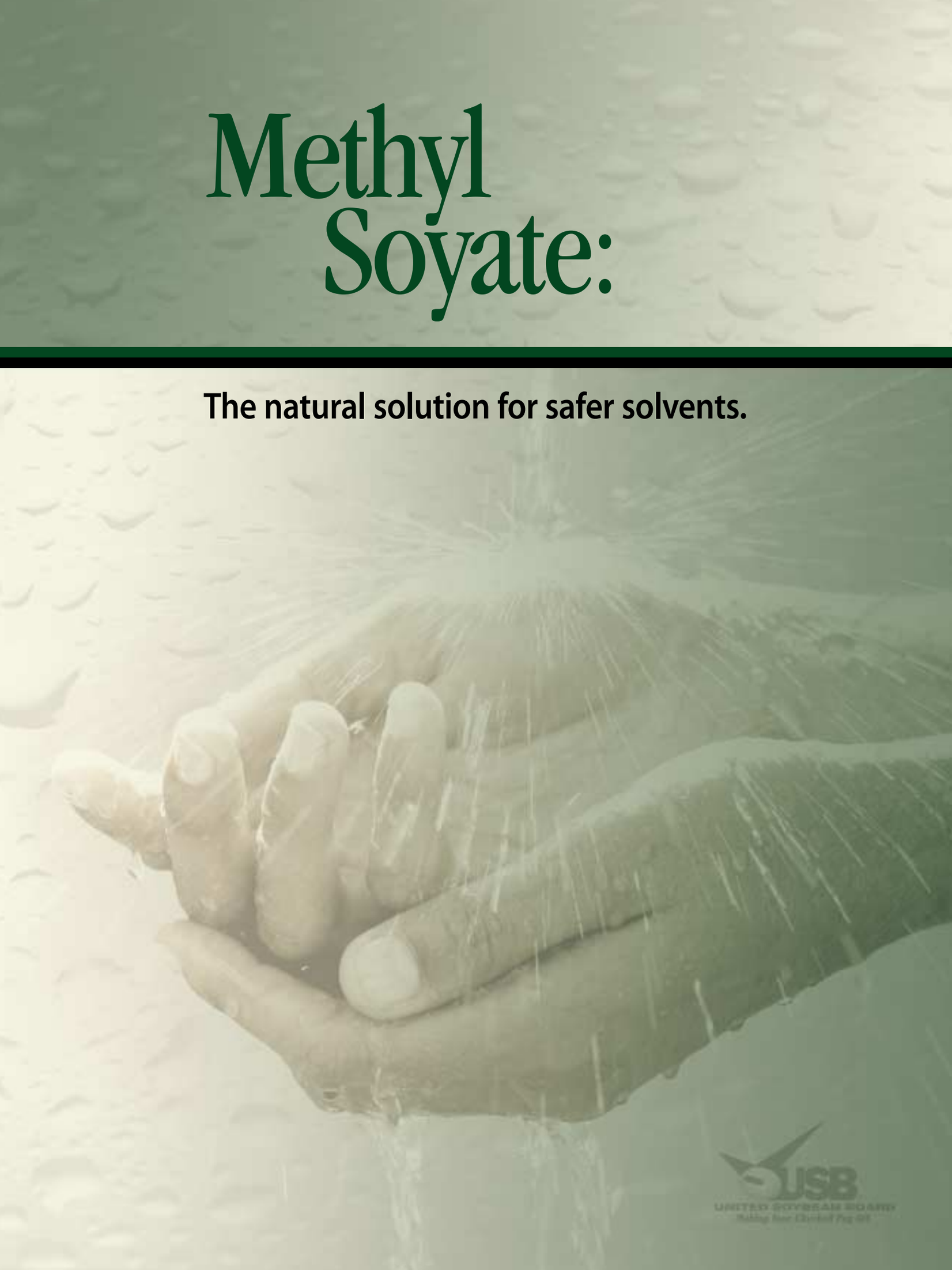
Methyl Soyate:

The natural solution for safer solvents.

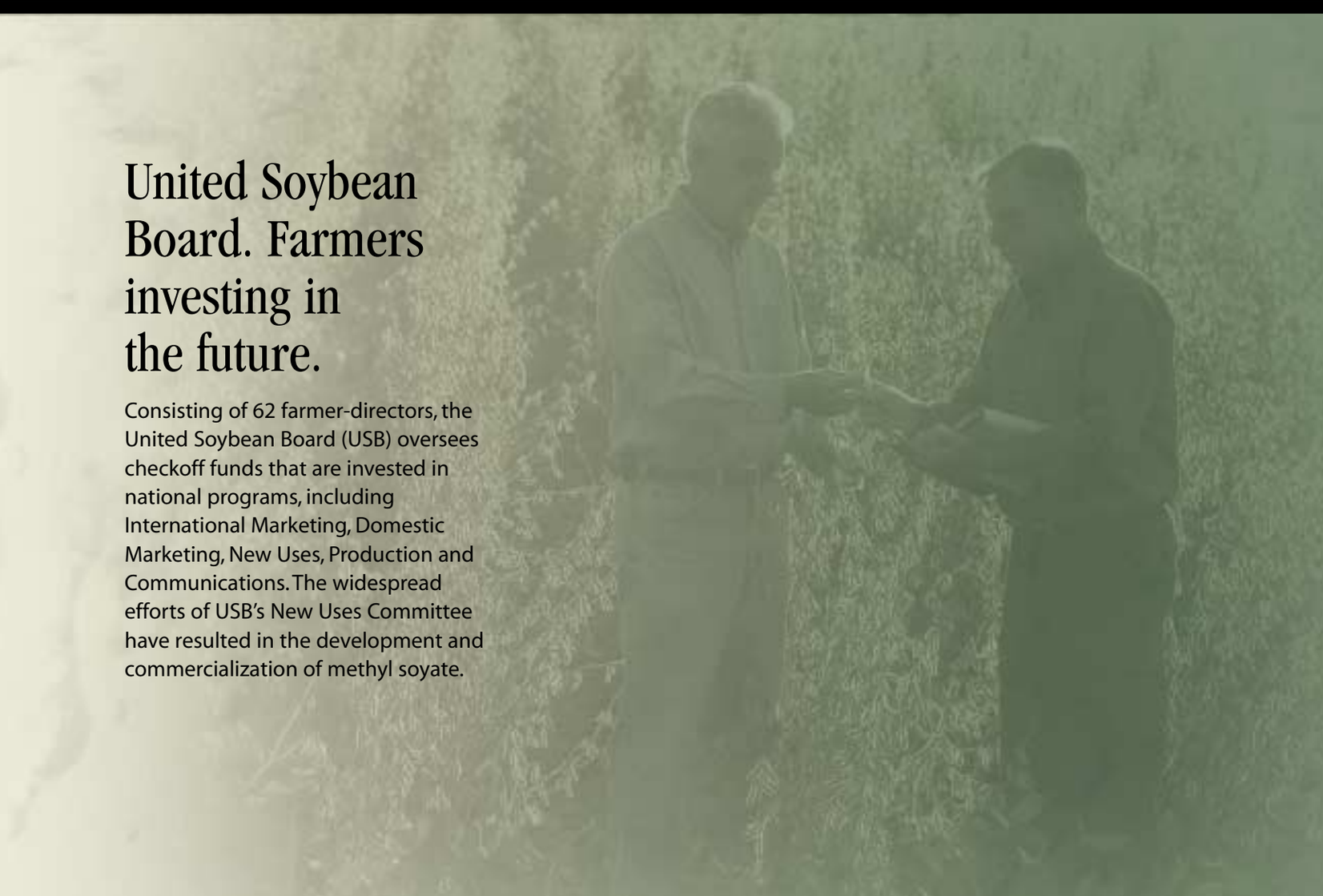


Methyl soyate is the product of soybean farmer initiative.

Every farmer in the country contributes to the soybean checkoff at the rate of 0.5 percent of the market price per bushel sold. These funds are invested in programs that can add value and increase demand for U.S. soybeans. Methyl soyate was developed because of soybean checkoff-funded efforts – and the foresight of U.S. soybean farmers.

United Soybean Board. Farmers investing in the future.

Consisting of 62 farmer-directors, the United Soybean Board (USB) oversees checkoff funds that are invested in national programs, including International Marketing, Domestic Marketing, New Uses, Production and Communications. The widespread efforts of USB's New Uses Committee have resulted in the development and commercialization of methyl soyate.



The manufacturing of methyl soyate.

As companies strive to improve safety for their employees and meet regulatory requirements, interest in biobased products that can replace petroleum-based chemicals is growing. One of these renewable solutions is methyl soyate – a petrochemical replacement derived from soybean oil.

Methyl soyate, or soy methyl ester, is produced by transesterification of soybean oil and methanol with a sodium hydroxide catalyst.

Methyl Soyate Process

$C_3H_5(O_2CR)_3$	+	3MeOH	Cat.	$3MeO_2CR$	+	$C_3H_5(OH)_3$
Triglyceride (soy oil)		Methanol	⟶	Methyl Soyate		Glycerine

Physical Properties of Methyl Soyate

Test	Value	Reference
Kauri-butanol number	58	ASTM D 1133
Volatile organic compounds	<50 g/mL	EPA Method 24; ASTM D 3960
Flash point (closed cup)	>100 C	ASTM D 93
Specific gravity	0.88	ASTM D 1475
Density	7.3 lb./gal.	ASTM D 1298
Vapor pressure	<1.0 mm Hg	ASTM D 5191
Evaporation rate	0.0098	ASTM D 3539
Boiling point	216 C	ASTM D 2887
Viscosity	3.9-4.3 mm^2/sec	ASTM D 445

Low VOCs. High flash point. Excellent solvency.

Methyl soyate makes sense in so many ways.

Produced from a renewable, biobased feedstock, methyl soyate offers numerous advantages over traditional solvents.

Safety advantages.

Methyl soyate provides a safer alternative to chlorinated, petroleum and oxygenated solvents. It offers very low flammability, a very high flash point (greater than 360 degrees F), low VOC levels (<50 g/l), low toxicity and is not listed as a Hazardous Air Pollutant (HAP).

Methyl soyate toxicity:

- Acute oral: LD_{50} > 5,000 mg/kg
- Acute dermal: LD_{50} > 5,000 mg/kg
- Skin irritation: 1.6 (nonirritating)
- Eye irritation: Nonirritating
- Skin sensitization: Moderate potential
- Mutagenicity: None (Ames assay)

Environmental advantages.

Made from soybean oil, methyl soyate offers many environmental and regulatory benefits. It is a non-ozone-depleting chemical (ODC), is non-SARA reportable, is readily biodegradable and offers potential for reduced waste-disposal costs.

Methyl Soyate VOC Analysis

Sample	Volatile %	Density (lb./gal.)	Water %	VOC minus water g/l	VOC minus water lb./gal.
1	3.08	7.33	1.08	18	0.2
2	3.58	7.38	0.73	25	0.2
3	6.35	7.35	1.04	47	0.4
4	5.12	7.31	0.00	45	0.4

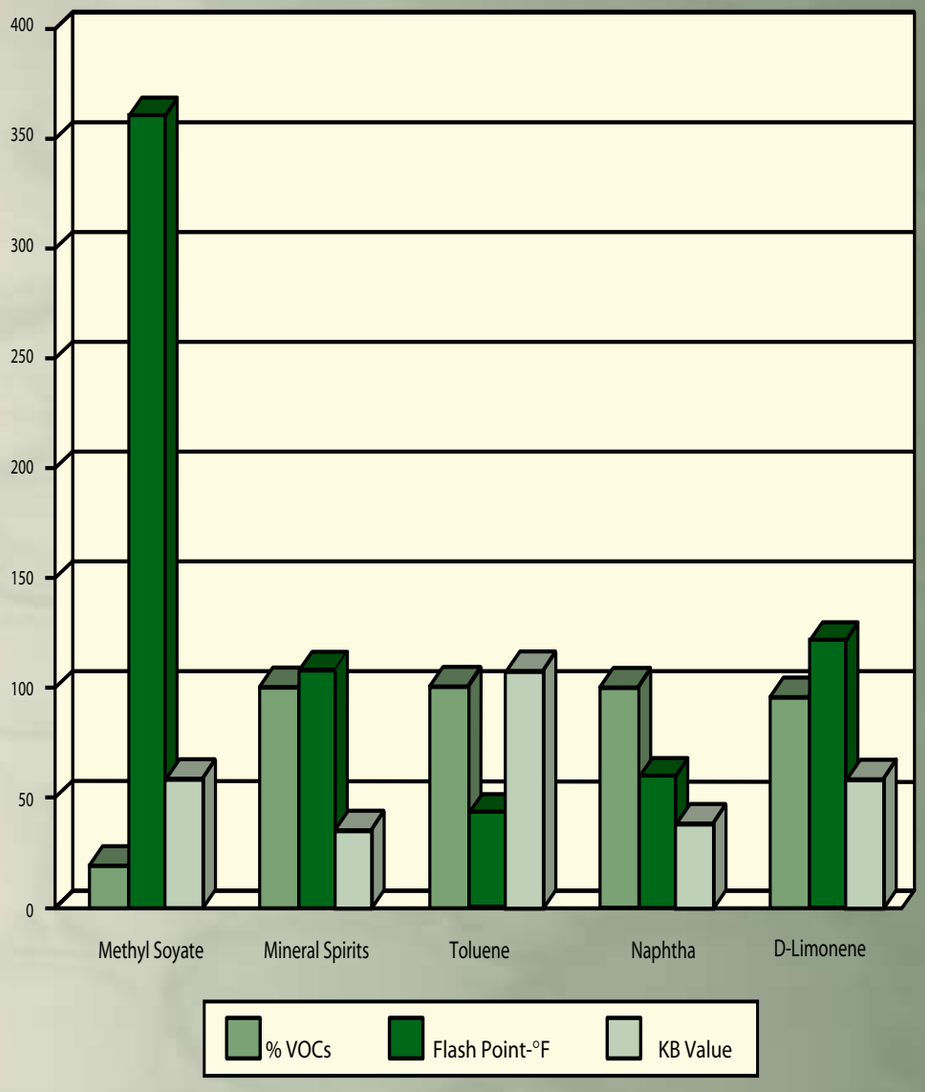
Test was conducted using procedures outlined in ASTM D 3960. Samples were used from four separate methyl soyate manufacturers.

Performance advantages.

Because of its versatility, methyl soyate can be used to formulate many types of products. It provides effective solvency with a kauri-butanol (KB) value of 58 and is compatible with other organic solvents. Typically, methyl soyate is formulated with co-solvents or surfactants to optimize product performance characteristics such as drying rate and water solubility.

Methyl soyate can be used to replace:
- Mineral spirits
- Trichloroethylene
- Methylene chloride
- Toluene
- N-methyl-pyrrolidone (NMP)

Methyl Soyate Physical Properties



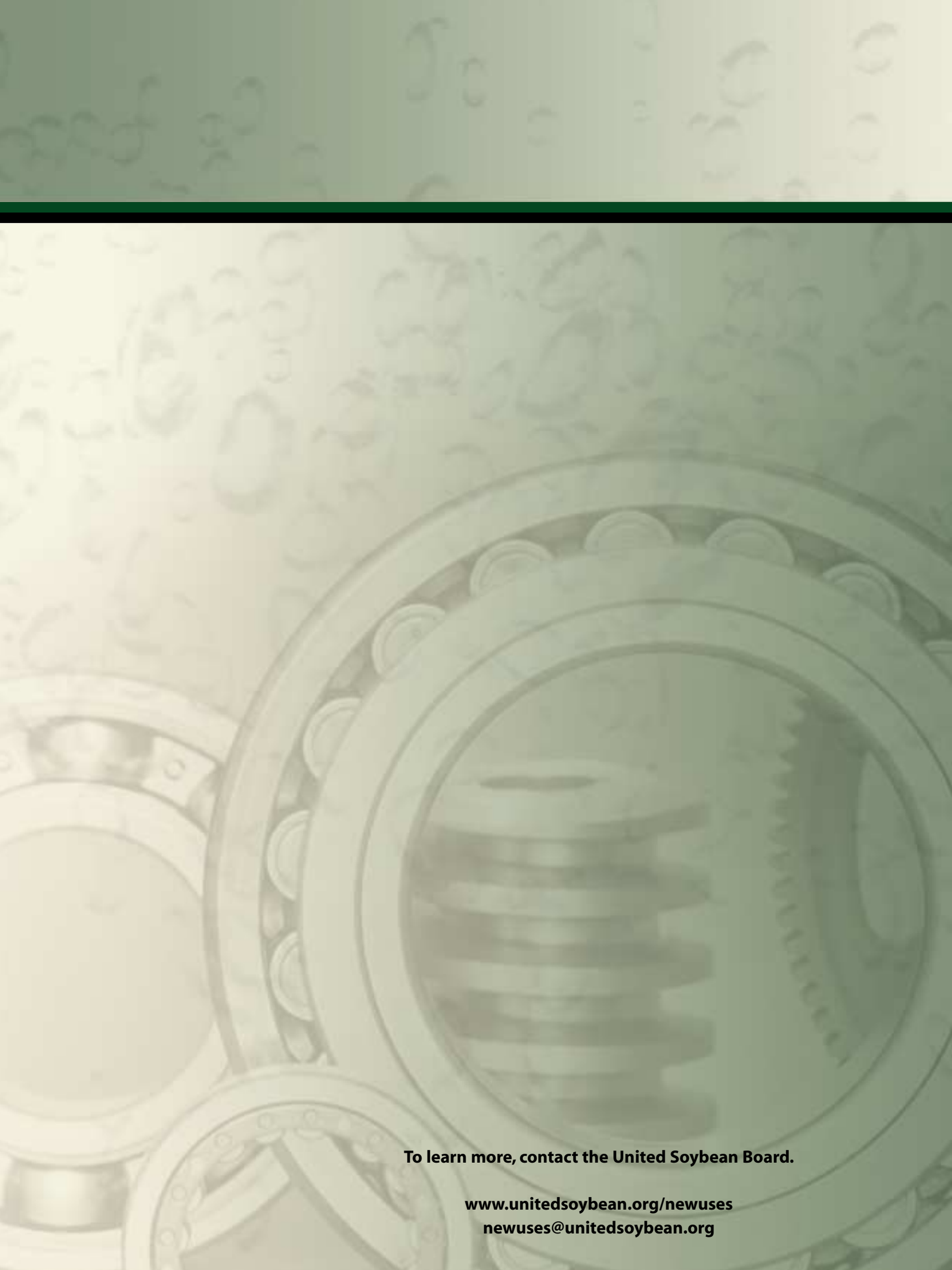
Methyl soyate meets environmental regulations.

- **Clean Air Act** (CAA; 1970, 1977, 1990): Methyl soyate is low in volatile organic compounds (VOCs) and is not classified as an ozone-depleting chemical or hazardous air pollutant (HAP), which means it passes CAA standards.
- **Clean Water Act** (1972, 1977): Methyl soyate has low aquatic toxicity and is readily biodegradable.
- **Toxic Substance Control Act** (TSCA; 1976): Methyl soyate is listed in the TSCA inventory.

Market applications for methyl soyate.

Methyl soyate can be utilized in a number of different formulated products as a safe solvent replacement. Its excellent solvent properties make it adaptable to a wide range of performance requirements.

- **Parts cleaning and degreasing.** Methyl soyate can replace petroleum and chlorinated solvents, such as mineral spirits and trichloroethylene, in basic parts cleaning processes. Other uses include household cleaners, food-processing equipment cleaning and asphalt cleaners.
- **Paint, ink and adhesive removal.** Applications include commercial and military paint strippers replacing methylene chloride, printing ink cleaners replacing toluene, adhesive removers replacing acetone and graffiti removers replacing mineral spirits.
- **Petroleum product cleanup.** Methyl soyate can be used for effective cleaning of oil spills on beaches and inland waters, as well as cleaning refinery reactors, storage tanks and processing equipment.
- **Carrier solvent.** This developing use for methyl soyate involves paints, wood and concrete stains and corrosion protection products.
- **Consumer products.** The safe properties of methyl soyate make it ideal for use in hand cleaners, skin lotions, shampoos and other personal care products.
- **Fuels and lubricants.** Uses for methyl soyate include lubricity additives, penetrating oils, metalworking fluids and form release agents for asphalt, concrete and metal fabrication. The largest use, however, is as the fuel base for biodiesel, which significantly reduces combustion emissions compared with petroleum diesel.



To learn more, contact the United Soybean Board.

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