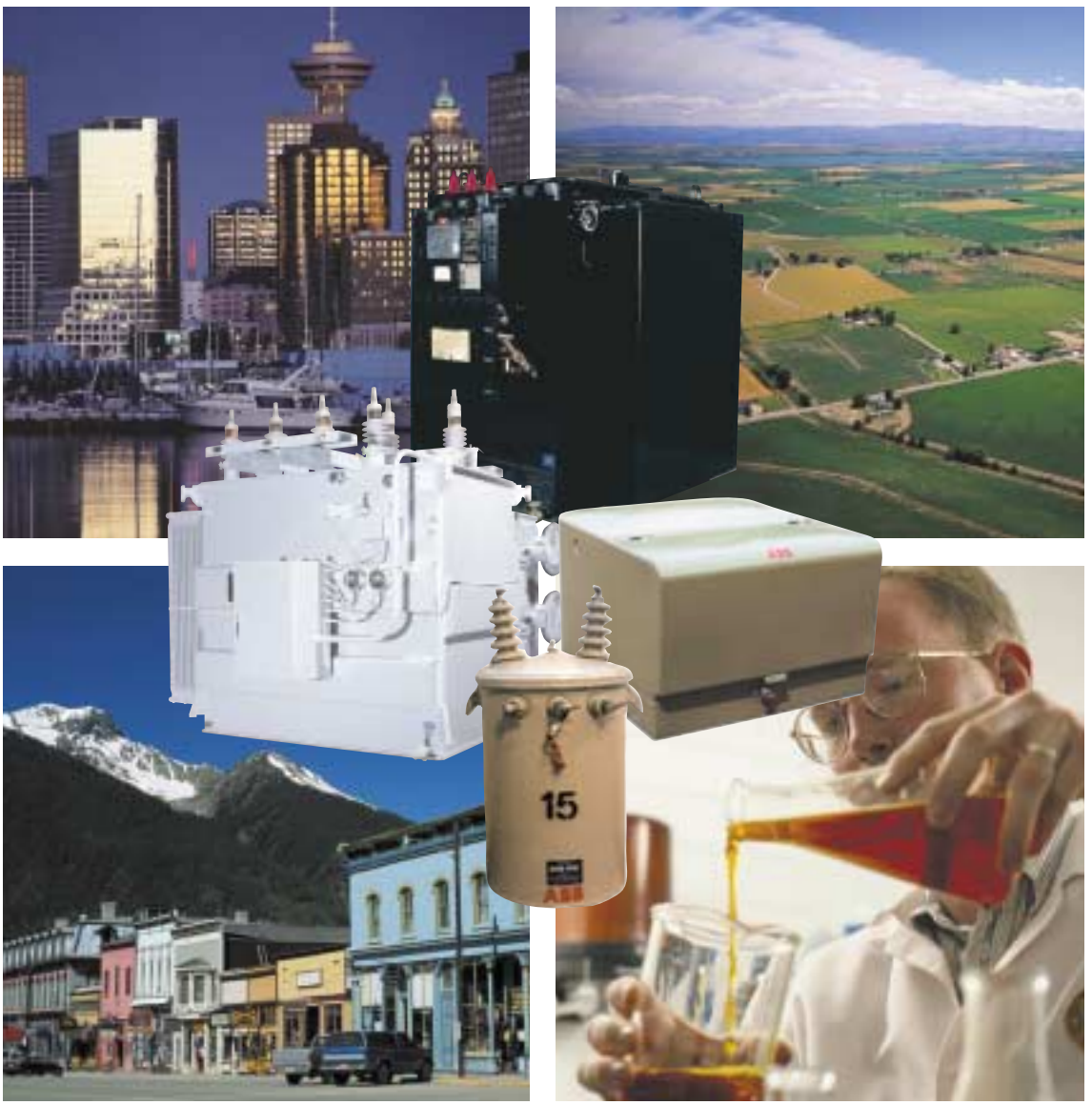
BIOTEMP®

Biodegradable Dielectric Insulating Fluid



BIOTEMP®

BIOTEMP® is an advanced dielectric insulating medium that was developed by ABB to be friendly to the environment. The fluid has excellent dielectric characteristics with high temperature stability and superior flash and fire resistance. BIOTEMP® has excellent compatibility with solid insulating materials and is biodegradable in a short time period.

BIOTEMP® is currently in use in small power and distribution transformers across the United States. The fluid has a proven success rate in heavily populated areas and in varying environments from the tropical environment of Hawaii to the frigid northern slopes of Alaska.

TYPICAL PROPERTIES OF INSULATING FLUIDS

	BIOTEMP	Mineral Oil	H.T.H.	Silicone
Electrical				
Dielectric Strengh, kV (ASTM D877)	45	30	40	43
Physical				
Viscosity, cSt. 100ºC	10	3	11.5	16
(ASTM D445) 40ºC	45	12	110	38
0ºC	300	76	2200	90
Flash pt. ºC (ASTM D92)	330	145	285	300
Fire pt. ºC (ASTM D92)	360	160	308	330
Specific Heat (cal/gr/ºC) (ASTM D2766)	0.47	0.43	0.45	0.36
Coefficient of Expansion, /ºC (ASTM D1903)	6.88×10^{-4}	7.55×10^{-4}	7.3×10^{-4}	1.04×10^{-3}
Pour pt. ºC (ASTM D97)	-15 to -25	-40	-24	-55
Sp. Gravity (ASTM D1298)	0.91	0.91	0.87	0.96
Color (ASTM D1500)	<0.5	0.5	0.5 - 2.0	<0.5
Environmental				
Biodegradation Rate (%) 21 - day CEC - L - 33	97.0	25.2	27.1	0.0

Environmentally friendly

BIOTEMP® is non-toxic to bird, animal and human life and is 97% biodegradable within 21 days when exposed to microbes. The fluid does not contain any petroleum, halogens, silicones or other materials that might adversely effect the environment.

BIOTEMP® is a renewable and biodegradable vegetable oil as defined under the Edible Oil Regulatory Reform Act of 1995. The fluid is based on a property-enhanced vegetable oil, combined with stabilizers to enhance oxidation stability.

Dielectric strength with improved tolerance to moisture

BIOTEMP® exceeds the dielectric strength of mineral oil and High Temperature Hydrocarbons (HTH's) and maintains dielectric strength with higher levels of moisture.

Moisture is soluble in BIOTEMP® up to 1100 PPM at room temperature. Moisture at this level does not result in the formation of a separate water (ice) layer. Free moisture (moisture levels above 500PPM) can have a negative effect on electric and chemical properties.

Due to the affinity of BIOTEMP® to absorb water, studies indicate that the life of insulation paper can be increased over transformer oil from petroleum sources. The study showed that BIOTEMP®/Kraft paper has double the life of mineral oil/Kraft paper with tensile strength and degree of polymerization measurements validating this conclusion.

When maintained in sealed equipment in the absence of dissolved contaminants and free water, BIOTEMP® does not form fungal or other biological growths. However, under extended warm conditions and in the presence of contaminants that can act as food materials for fungi, free moisture may lead to biological growths in the unit. As with other fluids, care must be exercised when handling and testing to keep the material clean and free of excessive moisture and exposure to oxygen.

Gas absorption and gas evolution

BIOTEMP® has many advantages over existing insulating fluids in relation to gas absorption and gas evolution under arcing. Testing has confirmed that only 25% of the total volume of gasses generated from petroleum based oils are produced when BIOTEMP® is arced. The gasses produced do not contain many of the polyaromatic hydrocarbons associated with arcing petroleum-based oils. Arcing BIOTEMP® produces carbon monoxide, hydrogen, and detectable traces of smaller hydrocarbon molecules.

Superior thermal characteristics

Pour point for BIOTEMP® is -15 to -25ºC; this value is comparable to HTH's. BIOTEMP® does not expand upon freezing and solidifies into a hard gel-like solid that still acts as both an insulating and cooling medium. In transformers, gas evolution from rapidly cooled BIOTEMP® has not been observed.

A unit filled with BIOTEMP® was cooled down to -70ºC and than energized at 100% full load. This load was maintained until the unit reached full operating temperature, 65ºC. The fluid returned from a solid to a liquid state as the operating temperature increased without detrimental effects.

The thermal properties of BIOTEMP® are superior to conventional mineral oil. The fluid has a lower oil temperature rise than mineral oil when used in transformers. Higher thermal conductivity results in improved heat transfer.

Compatibility with materials

BIOTEMP® is not affected by reactions

with other materials of transformer construction and is non-oxidizing and non-corrosive at temperatures considerably above normal operating temperatures.

High temperature stability

BIOTEMP® has distinct advantages over other high temperature dielectric fluids with fire and flash points well above 300ºC. BIOTEMP® is difficult to ignite and produces only carbon dioxide and water without harmful polyaromatic or silicate byproducts when burned.

Oxidation Stability

BIOTEMP® is provided with oxidation inhibitors at a level non-toxic to humans. During the normal expected life of a unit, the oxidation inhibitors in the fluid should provide more than enough protection from oxidative degradation. Units are shipped under a dry nitrogen blanket and excessive oxidation should not occur unless the fluid is left exposed to air for several hours without degassing before prolonged operation.

Oxidation stability testing shows that BIOTEMP® remains liquid and sludge does not form. Although neutralization values in some cases exceed the maximum specifications set for mineral oil at 72 and 164 hours, Life Test results show that this is not detrimental to the operation of the transformer.

Fire Safety and Codes

Factory Mutual has listed BIOTEMP® as a "Less Flammable" fluid and Underwriters Laboratories classifies it as a "Less Hazardous" dielectric medium in respect to fire hazard. Dielectric fluids are not currently available on the market that can exceed the flash and fire points of BIOTEMP®.

Storage and handling

BIOTEMP® can be transferred and stored similar to petroleum based fluids. Transfer equipment and storage vessels should be clean and free of contaminates and moisture. During storage, the vessel should be airtight and is preferably stored under dry nitrogen. BIOTEMP® is not an aggressive solvent and is not known to degrade rubber hoses or membranes.

Recommended Maintenance

Degassing and refilling the headspace with dry nitrogen after prolonged or frequent exposure (totaling more than five hours) to air is necessary for the life of the fluid. Periodic maintenance tests should follow the same schedule used for mineral oil-filled equipment.

BIOTEMP® TYPICAL FLUID PROPERTIES

Property	Value	Test Method
Electrical		
Dielectric Breakdown, min.	45 kV @ 25ºC	ASTM D877
Dielectric Breakdown, min.	32 kV @ .04" gap 65 kV @ .08" gap	ASTM D1816
Dissapation Factor (Power Factor) max.	0.15% @ 25ºC 2.0% @ 100ºC	ASTM D924
Relative Permittivity (Dielectric Constant)	3.2 @ 25ºC	ASTM D924
Volume Resistivity	1 x 10^{13} Ω-cm @ 100ºC	ASTM D1169
Dielectric Breakdown, Impulse, min.	100 kV (- needle) 90 kV (- needle)	ASTM D3300
Gassing Tendency, max.	+5.0	ASTM D2300
Physical		
Color, max	<0.5	ASTM D1500
Coefficient of Expansion	6.88 x 10^{-4}/ºC	ASTM D1903
Flash Point, min.	330ºC	ASTM D92
Fire Point, min.	360ºC	ASTM D92
Pour Point, max.	-15 to -25ºC	ASTM D97
Specific Gravity, max.	0.91 @ 15ºC	ASTM D1298
Specific Heat (Cal./ gm./ºC)	0.57 @ 25ºC 0.60 @ 100ºC 0.67 @ 200ºC	ASTM D2766
Thermal Conductivity, W/(mK)	0.17 @ 25ºC 0.26 @ 100ºC 0.36 @ 200ºC	ASTM D2717
Viscosity, cSt. max.	10 @ 100ºC 45 @ 40ºC 300 @ 0ºC	ASTM D445
Visual Appearance	Clear & Bright	ASTM D1524
Chemical		
Corrosive Sulfur	Non - Corrosive	ASTM D1275
Inorganic Clorides & Sulfates	Non - Detectable	ASTM D878
Moisture Content, max.	150 PPM	ASTM D1533
Neutralization Number (Acid), max.	0.075 mg. KOH/gm.	ASTM D974
PCB Content	Non - Detectable	ASTM D4059

Applications

BIOTEMP® is suitable for application indoors and in areas of heightened environmental sensitivity where any insulating fluid spill could require expensive clean-up procedures.

Retrofilling Transformers

BIOTEMP® mixes in all proportions with mineral oils. Concentrations of mineral oil in excess of 10% by weight may lower the fire point below 300ºC. BIOTEMP® does not mix with silicone fluids.

Specification Guide

The dielectric coolant shall be listed less-flammable fluid meeting the requirements of National Electrical Code Section 450-23, including a minimum fire point of 300ºC and the requirements of the National Electrical Safety Code (IEEE C2-1997), Section 15. The fluid shall be non-toxic, non-bioaccumulating and biodegradable. It shall be Factury Mutual Approved and UL Classified, BIOTEMP® Fluid or equal.

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ABB Inc.

2135 Philpott Road
South Boston, VA 24592
(434) 575-7971 Fax: (434) 575-2208

www.abb.com/transformers