Report on a Replacement for Askarels

Coil and Motor Manufacturing Tips

Silicone-Based Dielectric/Coolant Faces Manufacturer/User Evaluation

Using askarels for transformer cooling is dangerous because of the environmental hazards involved, and monitoring, controlling, and disposing of PCB's is costly. Mineral oils present a flammability problem, and gas- and air-cooled transformers have high operating losses.

When he must find an adequate substitute for askarels, the power transformer manufacturer or user needs an environmentally safe liquid coolant with high temperature stability, excellent dielectric properties, and low flammability. Dow Corning Corp., Midland, Mich., believes that it has developed a silicone coolant* that meets these requirements.

The coolant, which is much less flammable than typical mineral oils, has a higher flash point than many askarels. It is self-extinguishing in static tank burns and simulated catastrophic transformer failure tests. Three years of evaluation have shown that existing transformers can be retrofilled with the liquid successfully. As a result, the company has announced the controlled availability of the material in a cooperative plan to gather additional practical data on a massive scale.

Silicone liquids rank among the least hazardous of industrially used chemicals; their low toxicity to aquatic, bird, animal, and human life is well documented, according to Dow Corning officials. Evaluated by Underwriters' Laboratory, the silicone liquid coolant for transformers received a flammability classification of between four and five (on an index which lists water as zero and ether as 100). Askarels are rated at two to three on the same index, and mineral oil, though not listed, would likely be rated between 10 and 20.

Data Program

Dow Corning's Commercial Service Life Data Program, under which the silicone liquid will be made available to the power transformer industry, provides for the collection and dissemination of performance data on the silicone coolant in large scale use under many types of operating conditions. It will involve three-way cooperation and exchange of information between transformer manufacturers and users and Dow Corning. The plan is necessary to inspire confidence in the liquid as a replacement for askarels.

The primary objectives of the program, which calls for the installation of 500 to 1000 power transformers in the 500 to 10,000 kVA class containing silicone dielectric coolant, are: 1) data — to gather operational information for three to five years, compile

*Dow Corning 561 Silicone Transformer Liquid. It is chemically identical to polydimethyl siloxane liquids which the corporation has produced for 30 years, but the new liquid is manufactured to tighter specifications for electrical use.

High current faults in closed tanks filled with (left to right) mineral oil, silicone liquid, and askarel were used to simulate internal failures in transformers. Silicone fluid exploded with less violence than either mineral oil or askarel.



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statistical performance records, and distribute results to participants; and 2) approval — to obtain complete qualification of the silicone liquid as a replacement for transformer askarels.

Dow Corning has presented data based on a concept of full-spectrum safety to Panel 13 responsible for the appropriate National Electrical Code (NEC) sections covering the installation of transformers. Similar presentations have been made to Factory Mutual, Industrial Risk Insurers, Hartford Steam Boiler, OSHA, UL, NBS, and others concerned with the safety of electrical systems. These agencies also are evaluating silicone liquid in appropriate test programs to confirm the safety of this liquid. Results of these tests will guide the establishment of new regulations and revised codes.

Presently, three transformer manufacturers are ready to accept orders for silicone liquid filled transformers: Small Power Transformer Div., Westinghouse Electric Corp., South Boston, Va.; RTE and RTE-ASEA Corp., Waukesha, Wis.; and Ferranti-Packard Ltd., Toronto, Can. All participated with Dow Corning in a cooperative evaluation of silicone liquid coolants.

FLAMMABILITY AND FLASH POINT

	Flash Point		Fire Point		Combustion Intensity*
	°C	°F	°C	°F	
Transformer Oil	150	302	165	329	15000
Silicone Liquid	277	530	316	600	900

*Kcal/min.

DIELECTRIC CONSTANT, DENSITY AND VISCOSITY

	Dielectric Constant	Viscosity @ 75° C (Centistokes)	Lb/Gal	
			Imp	US
Oil	2.3	5	8.5	7.1
Askarel	4.5	6	15.25	12.7
Silicone	2.7	20	9.6	8.0

Element of Risk

Until silicone transformer liquids are accepted fully under the National Electrical Code and blanket approval is given by insurance companies, customers must recognize that there may be an element of risk in placing silicone filled units in hazardous locations. This must be weighed against the consequences of strict environmental regulations proposed for askarel spills and the fact that the sole supplier of askarel plans to phase out of production.

Responsibility for proper clearances with insurance underwriters, government regulatory agencies, and local code authorities rests with the transformer buyer. Three leading fire underwriters — Factory Mutual, Hartford Steam Boiler, and Industrial Risk Insurers — have indicated their willingness to approve individual installations on a case-by-case basis. Until the National Electrical Code is revised, it is also necessary to obtain waivers from OSHA to install silicone filled transformers. The necessary petitions for such approval have been submitted to OSHA.

Pumping equipment for the silicone liquid must be selected with care because the liquid does not adequately lubricate certain pump designs. Poor lubrication will cause premature pump failure and contaminate the liquid with metal particles.

A silicone liquid-filled transformer will cost more than an equivalent askarel filled unit because of the higher cost of the silicone liquid and because the difference in viscosities (silicone is higher) will necessitate additional cooling for the silicone filled unit if the same temperature rise is to be maintained. Temperature rises up to 10% higher have been observed when silicone was substituted directly for oil or askarel. If additional cooling capacity is not provided, a transformer may have to be derated.

Maintenance Procedures

Standard maintenance procedures developed for oil or askarel filled transformers generally apply to silicone filled transformers. The only check required on the silicone liquid is for dielectric strength using liquid filled transformer procedures in accordance with ASTM D877 except only one breakdown per cup filling should be made.

The dielectric strength of the silicone liquid is equivalent to askarel and oil. The liquid exhibits a high degree of thermal stability. Low volatility and resistance to thermal oxidation should enable the liquid to maintain insulating and other functional properties for extended periods of time at high temperatures.

The explosion hazard under catastrophic fault conditions is not totally eliminated with silicone coolants. Under catastrophic fault conditions, internal arcing and decomposition of the dielectric coolant can cause violent transformer explosions. Transformers cooled with mineral oil, askarel, and silicone fluid were subjected to catastrophic failures by Dow Corning. All three dielectric coolants exploded, but only the mineral oil continued to burn after the explosion. The askarel exploded violently, but quickly self-extinguished. Silicone exploded with considerably less violence and also did not continue to burn. It limited the arc duration and self-cleared

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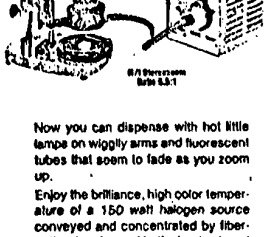
WITH RINGLIGHT



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