



Study Committee B2

OVERHEAD LINES

10757_2022

Field and laboratory Assessment of Room Temperature Vulcanized Coated Insulators in Harsh Desert Environment

Raouf ZNAIDI
Consultant
Tunisia

Ahmad Al-THAGAFI
GCCIA
KSA

Abdellah BOUCHTI
OMEXOM
KSA

Motivation

The main aim of this intensive works achieved by GCCIA working Group in both Al-Fadhili in KSA and Al-Zour in Kuwait testing stations as well as in different accredited laboratory intend to assess natural ageing of 3 different formulations of silicone rubber coating and attempt to estimate their operating life after three years exposure in above mentioned certified "GCCIA Naturally polluted insulators testing Stations" Fig(1) and (2) .

Methodology and Technical Approach

The internationally proved Rapid Flashover method (RFO) tests, mostly based on Cigre TB (especially 691/2017 and partly on IEC-60507) has been selected for Comparative electrical performance tests in accredited laboratories (Fig 3 & 4) between naturally aged & polluted coated insulators (removed after 3 years from testing stations and OHTL.) in comparison with similar not aged coated insulators.



Fig (1) and (2) Al Fadhili KSA and Al Zour Kuwait Naturally Polluted Insulators Testing Stations.

All RFO test results, performed in different accredited laboratory and under the same conditions on open type coated Glass Insulator discs have showed the following main results :

- After 3 years exposure to combined desert and industrial and marine pollution in energized testing station in KSA and Kuwait , noticeable natural ageing in varying degrees in terms of electrical performance of 3 different RTV coating (RTV1, RTV2 and RTV3) have been observed.
- Manifest loss of initial hydrophobicity** have been clearly demonstrated after each flashover.
- After localized partial loss of silicone rubber hydrophobicity, progressive hydrophobicity recovery have been observed day after day.

(**) Note: Testing on time recovery of hydrophobicity is a major issue on the upcoming Cigre Experts' Agenda.

Conclusion

- As an attempted of extrapolation and to answer to most popular question regarding shelf life of sir coating we can scientifically estimate that operating life expectancy of Sir coatings RTV2 and RTV1 could be in the range of 8-9 years.
- According to RFO test results performed in different accredited laboratories on aerodynamic insulators coated with 3 different sir coating formulation silicone rubber RTV2 is the best ranked in terms of ageing performance in Al Fadhili Region...
- According to global results, Al Fadhili (in KSA) & Al Zour (in Kuwait) Testing stations offer an alternative way for ageing tests & for selecting the most suitable insulator profile & silicone rubber coatings for each study area...



Fig(3): Preconditioning tests



Fig (4): Wetting process

Main Testing Results: Evident Ageing

a) Study Case of Fully Coated Insulator With Silicone Rubber (RTV1):

Table 1. Near aged fully coated insulators						Table 2. Naturally aged fully coated insulators					
$\frac{U_{50}}{U_{100}}$	ROV1 kV	ROV2 kV	FOV3 kV	Avg. kV	HC2	$\frac{U_{50}}{U_{100}}$	ROV1 kV	ROV2 kV	FOV3 kV	Avg. kV	HC2
Disc 1	61	59	57	59	1	Disc 1	57	33	33	41	4
Disc 2	57	54	54	54	1	Disc 2	53	32	33	39	4
Disc 3	51	56	56	54	1	Disc 3	40	42	38	40	5



Fig(5): Significant decline of electrical performance of naturally aged RTV1. VS not aged RTV1 coating.

Study Committee B2

OVERHEAD LINES

10757_2022

Field and laboratory Assessment of Room Temperature Vulcanizing Coated Insulators in Harsh Desert Environment continued

Main Additional Testing Results:

a) Study Case of Fully Coated Insulator With Silicone Rubber (RTV1):

As shown in Tables 1 and 2, the residual electrical performance tests of naturally aged insulators, fully coated with silicone rubber RTV1, are in the range of 40kV while the average of flashover voltage for not aged insulators coated with the same RTV1 were in the range of 56 kV corresponding to a decreased performance in the range of 29% after 3 years in energized test station Fig(5).

Table 1. Not aged fully coated insulators

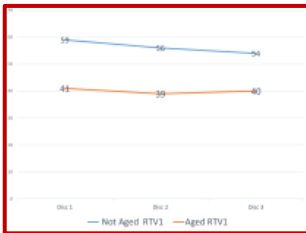
	POV1 kV	POV2 kV	POV3 kV	Av. kV	HC1		POV1 kV	POV2 kV	POV3 kV	Av. kV	HC2
Disc 1	61	59	57	59	1	Disc 1	57	39	39	45	6
Disc 2	57	56	56	56	1	Disc 2	53	32	33	39	6
Disc 3	51	56	56	54	1	Disc 3	49	42	39	49	5

Table 2. Naturally aged fully coated insulators



Fig(6) - Significant decline of electrical performance of naturally aged insulators half coated with RTV3 coating

In addition, the partial losses of initial hydrophobicity (HC1 for not aged) have been also demonstrated after each flashover (HCS and HC6 for aged one).



Fig(5): Significant decline of electrical performance of naturally aged RTV1. VS not aged RTV1 coating.

b) Study Case of Half Coated Insulator With Silicone Rubber (RTV3):

As shown in Tables 3 and 4, the residual electrical performance tests of naturally aged insulators half coated (bottom side only) with another silicone rubber formulation RTV3, were in the range of 28kV while the average of flashover voltage for not aged insulators coated with the same RTV3 were in the range of 49 kV corresponding to a same decreased performance in the range of 42%, after 3 years in energized test station Fig(6) .

In addition, the monitored highest leakage currents were in the range of 240 mA while partial losses of initial hydrophobicity (HC1 for new coated) of coated bottom side have been also demonstrated after each flashover (HC6 for naturally aged one).

Table 3. Not aged half coated insulators & highest Leakage currents

	POV1 kV	POV2 kV	POV3 kV	Av. kV	Av. highest Leakage Currents	HC
Disc 1	52	43	54	50	65	1
Disc 2	50	43	54	49	50	1
Disc 3	55	43.5	45	48	53	1

Table 4. Naturally Aged Half Coated Insulators & Highest Leakage current

	POV1 kV	POV2 kV	POV3 kV	Av. kV	Av. highest Leakage Currents	HC
Disc 1	31	27	24	27	150	6
Disc 2	32	32	24	29	225	6
Disc 3	30	30	28	29	240	6

As clearly shown in tables 5, 6 and 7, a significant decrease of electrical performance in the range of 30% of 3 tested Sir Coating RTV1, RTV2 and RTV3, more especially RTV3, removed after three years exposure in Al-Fadhili testing station (KSA).

Table 5

U160 KN full Coated with RTV1. Type A.	AV.FO Not aged	AV.FO Aged	Ageing Factor In %
	59	41	31%
	56	39	30%
	54	40	26%

Table 6

U160 KN full Coated with RTV2. Type B.	AV.FO Not aged	AV.FO Aged	Ageing Factor In %
	61	39	36%
	56	42	25%
	60	47	22%

Table 7

U120 KN Half Coated with RTV3. Type C.	AV.FO Not aged	AV.FO Aged	Ageing Factor In %
	50	27	46%
	49	29	41%
	48	29	40%

Study Committee B2

OVERHEAD LINES

10757_2022

Field and laboratory Assessment of Room Temperature Vulcanizing Coated Insulators in Harsh Desert Environment continued

Testing Procedure:

- Preconditioning tests: each string insulators of 3 ceramic discs have been subject to a preconditioning period of 20 minutes, as shown in Fig(3).
- Checking of temperature and relative humidity of testing hall before each test lot.
- All individual RTV coated Insulator disc (single disc for our case) has been tested in vertical position, as shown in Fig(4).
- With the view to simulate as close as possible the early dew impact on outdoor insulation all top and bottom tested insulator surfaces have been manually wetted using distilled water spray before and after each RFO test. The distance between spraying bottle and insulator disc should be in the range of (15-20 cm) Fig(4).
- Hydrophobicity class estimation has been simultaneously checked before and after each RFO tests.
- 90% of the average of 3 obtained FO voltage values during preconditioning tests has been applied to the insulator as a reference voltage.
- The test voltage is then raised by a smooth ramping process about 5% of flashover voltage every 3 minutes until flashover.
- The relevant value of this RFO tests is characterized by the mean of 3 successive flashover voltage values for each disc.
- Maximum total test duration should do not exceed 100 min.

Partial Loss Of Hydrophobicity And Time Recovery Of Tested Sir Coating.

After visible superficial discharges by daylight, several cap and pin 120KN insulators were removed from GCCIA network. This removed insulators have showed a complete hydrophilic states on both top and bottom sides of discs surfaces .

In an attempt to confirm if it was the beginning of end of operating life of silicone coating or just a partial loss issue of hydrophobicity. Hydrophobicity measurements have been performed after 24 H and 48 H successively on disc 7 and 9 removed from the same 400KV suspension string that have showed a visible progressive partial hydrophobicity recovery from HC5 and HC6 to HC4 of their coating after 48 Hours rest in the laboratory. As shown in Fig (7) and (8).

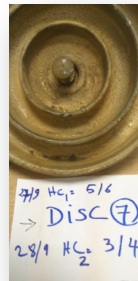


Fig (7)



Fig(8).