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UTILISATION OF CERAMIZING MATERIALS IN FIRE RESISTING CABLES AND ACCESSORIES

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SAFETY CABLES: WHY?

Maximum Security in tunnels and heavily populated public areas.
Due to the tragic incidents seen in several tunnels during recent years across Europe, we had to re-examine the performance of materials under fire conditions.
… The requirement for safety cables and systems is more demanding now than ever.

1) Fire performances of cables

In case of a fire, saving human lives may depend on the quality of a single piece of insulated conductor.
Cables that fulfil these fire performances are designated as safety cables.
Safety cables are used for:

- Energy distribution…,
- Data transmission, fault detection…,
- Loudspeaker systems etc..!

The design of cables with these high fire capacities have to be built using specific compounds and employ special cable operations.
Following various consderations, and tests in fire conditions, we found that the utilisation of Silicone compound as an insulation material over copper conductors combined with a new ceramifiing © bedding compound, resulted in excellent fire performances.
The merging of these two materials which ceramizes, when exposed to fire, will harden and form compact layers.
The combustion residue from the burned Silicone compound, have also very good electrical values.
In consequence this type of insulation is ideally suitable in cables for energy but also for audio, data-transmission and security control systems.

2) Fire performances of cable accessories

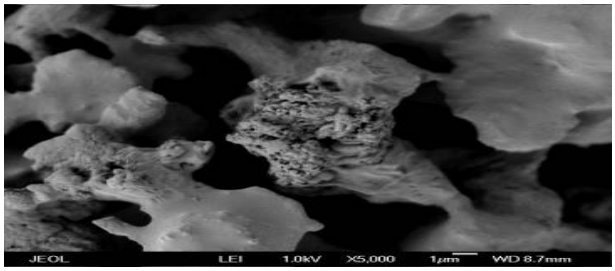
The mechanical characteristics of the ceramized combustion residue of silicone are stable and enable us to construct cable junctions that can withstand the required fire conditions and ensure functional integrity during a fire.
They are compatible to the cables characterised in the prevent description.

3) Composition of the Safety cables

A) Insulation

A special silicone compound is used which ceramizes when hit by fire.
The extrusion of this compound can be handled like other non-ceramizing silicone compounds.
The cross linking occurs in the salt bath. We are able to extrude cables in sizes and types of conductors (plain, rope or stranded) from 0.50 up to 630mm².
What happens when the insulated cables are hit by fire?
The ceramization of the silicone occurs even under temperatures of 700 – 1000°C.
It becomes a tubular layer of char around the conductor.
A mechanically stable and less fragile ceramic, comes from the combination of inorganic fillers and the microscopic mineral fibres, as a result of combustion-fusion of parts of the compound.
In the future also as ceramifing © thermoplast compound.

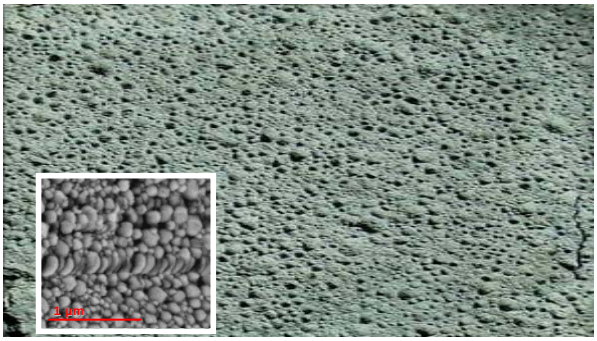
Picture 1: In this state the result is comparable to concrete.



Picture 2: Detail view x 5000.

B) Bedding

In a similar manner, the new kind of ceramifiing © thermoplast bedding compound acts as a fire/heat barrier.
The controlled degree of swelling, the resultant multiple micro bubbles and the hard ceramized ash, means that this compound is well-defined for this application.



Picure 3: Detail of ceramized bedding compound

4) Cable Construction

The cable construction has to be designed so that no fire propagation and circuit integrity under fire condition up to 1000°C can be achieved.
The most common international standards are, IEC 60332-3, IEC 60331, EN 50200 and the German DIN 4102 part 12.

It has to be borne in mind that especially test DIN 4102 part 12 calls for stringent requirements and the test will only be successful if the mounted cables along with the whole system (cables and mounting equipment), will remain operational for a period of 30, respectively 90 minutes.

Picture 4: real fire stress during test

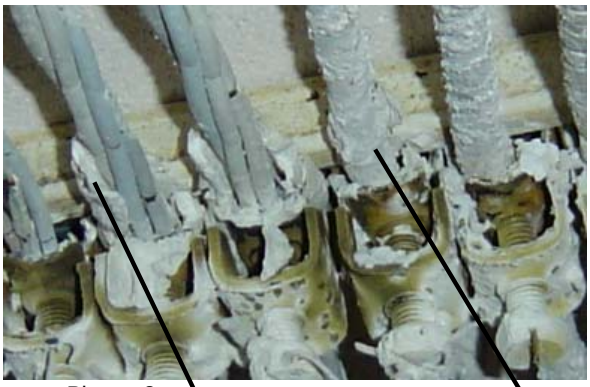
Cables with solid class 1 or semi-rigid stranded class 2 copper conductors have proved rugged mechanical stability. They are best to keep the insulation in place and form a firm harden tube around.
The ceramizing silicone insulation, consist of an approved method to built these fire safety cables.
But where flexible conductors are implicated, this insulation alone is not enough to withstand the additional mechanical stress.

Picture 5: Class 5 insulated conductors / cracks in formation

Due to the formation of micro cracks in the silicone ashes and by the high torsion pressure in the above-mentioned fire test, the flexible class 5 and 6 cable will, in our experience, fails.
The micro fissures grow and let the heat penetrate. The result is a decrease of stability followed by a disintegration of the conductor.

Picture 6 & 7: mechanical stress

To be able to perform this test, the twisted insulated conductors have to be covered by an additional layer of filling compound.
For this case a new kind of ceramizing bedding compound has been developed.
The residual ashes swell up to form a thermal shield, and the stability of the cable is attained.



Picture 8:
Conventional HFFRbedding>>>Ceramifiing© HFFR bedding
The construction with these materials guarantees a **better and safer functionality** of cables during fire stress!

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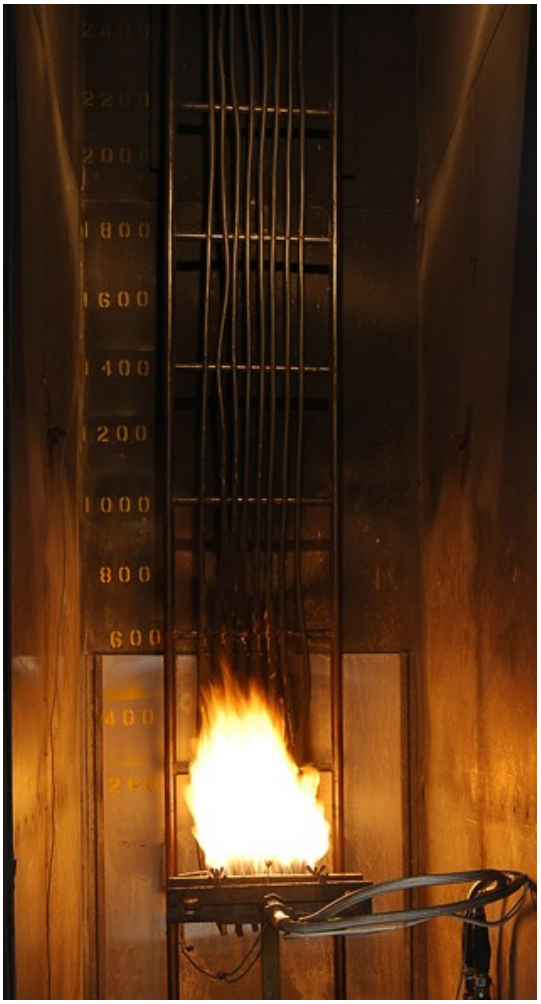
5) Different fire tests

Picture 9 a&b: DIN 4102 part 12 before and after 90min in fire

Picture 10: EN 50200 PH 15…120
Circuit integrity with hammer knock

hammer



Picture 11: no fire propagation IEC 60332-3-24

Picture 12: IEC 60331 circuit integrity

The cables and junctions designed in accordance with these tests which guarantee function under fire conditions, are also halogen free, low smoke and do not emit toxic gases.
They represent an ideal solution where human life is at stake!