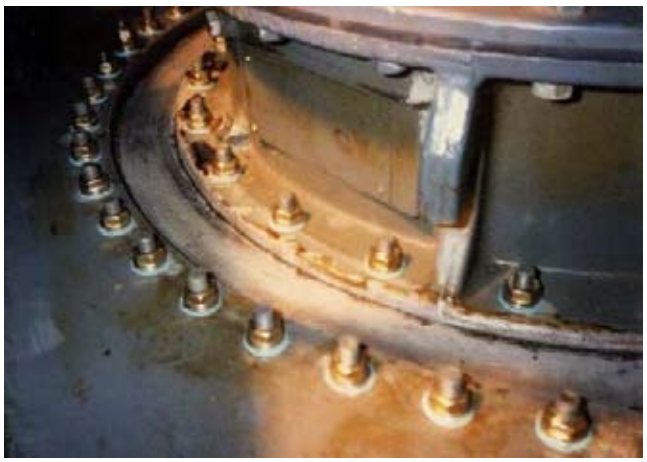
Worldwide repairs carried out with PolymerMetal®

REP-# 002



Sealing of an oil leak between the cover and diverter switch of a transformer with MM-Elastomer 95. First the oil in the transformer was drained and the surface thoroughly cleaned with MM-Degreaser Z. Finally MM-Elastomer 95 was applied using a brush.

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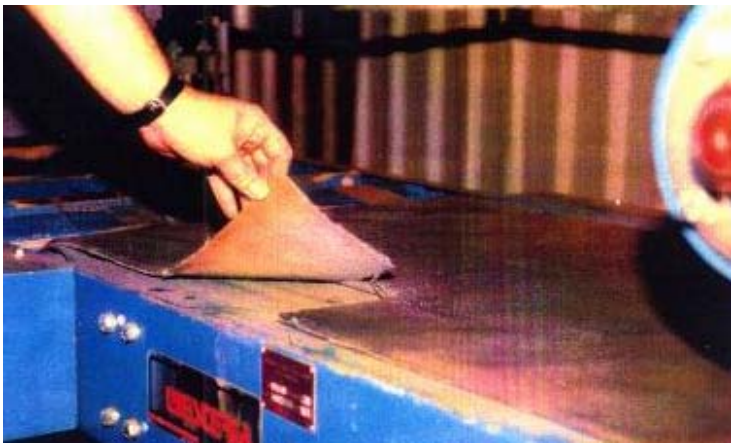
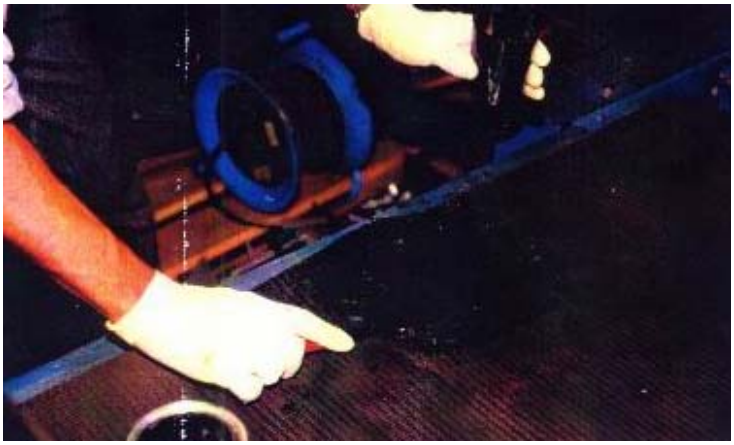
REP-# 101





A conveying belt of a compost filling plant showed a 120 mm x 130 mm long triangle fracture at the corner. After cleaning and degreasing with MM-Degreaser Z an application of MM-Elastomer 95 with Hardener EL95 was done. Afterwards the conveying belt was put into action again with a tensile stress of 5 bar.

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Worldwide repairs carried out with PolymerMetal®

REP-#148












Several holes and damaged spots respectively in the roof of a big tank at an oil refinery were first grinded and cleaned to prepare the surface and then coated with Ceramium. Then the Ceramium was grinded to rough up the surface. Finally a layer of MM-Elastomer was applied to compensate any bigger tensions.

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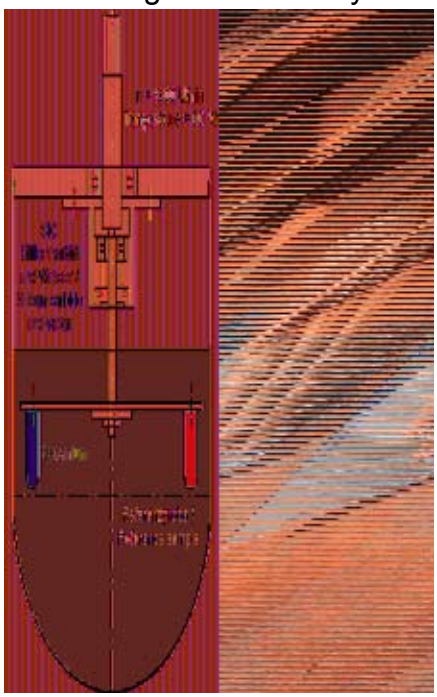
Technical Report PolymerMetal®

TEC-# 001
Wear behaviour of polymer materials

Used products
Ceramium, VP 10-017, MM-Elastomer

Description
Mechanical and chemical stress acting on surfaces lead to wear and corrosion. If a high wear resistance is required, usually a very high hardness is needed, too. The hardness – Vickers, Brinell or Rockwell hardness – of polymer materials, like PolymerMetals or polymer ceramics, is meaningless for nearly all wear mechanisms of wear stressed machine parts. Mixtures of ceramic, metallic and polymer materials as well as elastomers show, that wear resistance and hardness do not correspond. Nowadays, erosive-abrasive wear stress is simulated with the help of a slurry pot or an abrasive wheel. The test in the slurry pot is very meaningful when the metals are exposed to sandy streamings. The water-sand mixing ratio determines the degree of wear. The adhesion between the sand grains is rising when the water content is very low. As a result wear is increasing as well. However, the influencing factors in praxis should not be underestimated. Tests carried out in model experiments help to determine the material's quality and to choose the right material. A guarantee for the durability cannot be given by these tests. Ceramium is a reliable material to protect metals against abrasion and surface destruction provided that the size of the particles is not more than 500 µm. In the following test a medium grain size of a very strong hardness was chosen: SiC ca 60 µm. Water and SiC were mixed in ratio 1 : 2 by volume. It is quite obvious that Ceramium was exposed to a very high stress.



The used materials showed the following results:

Material	Hardness (Vickers)	Wear (after 30 days)
Ceramium	HV 28	2,93 ccm
Tool steel	HV 840	3,60 ccm
Steel St-52	HV 120	7,20 ccm

In case that the particle size is higher than 500 µm the wear of Ceramium increases progressively. MM-Elastomer and VP 10-017 show a better wear resistance, because they are plastically deformable. On the other hand, it has to be considered that the bonding on water-stressed metal surfaces of all elastomer materials is diminishing with advancing time.

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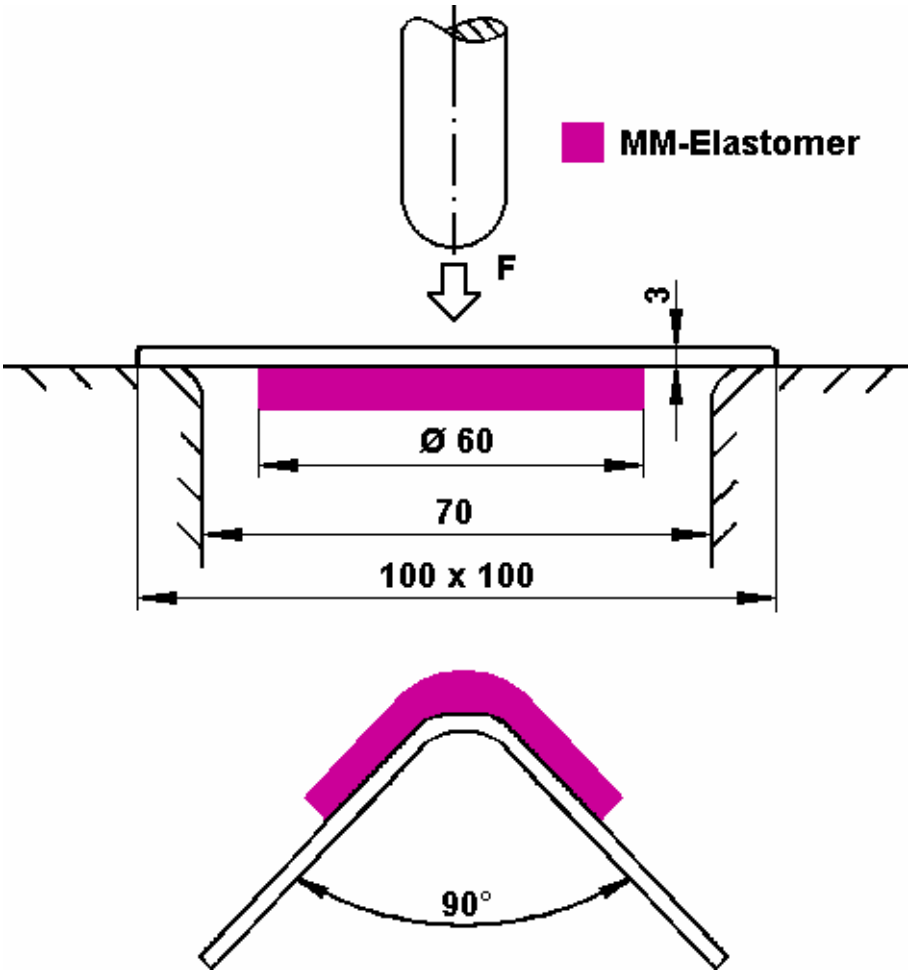
Technical Report PolymerMetal®

TEC-# 004
Bending-Peeling-Test according to „Trietsch“

Used products
MM-Elastomer 95, MM-Elastomer 85, MM-Elastomer 65, MM-Elastomer 40



Description
The surface of a 3 mm thick aluminium sheet was grinded and thoroughly cleaned. Then MM-Elastomer was applied to the aluminium sheet in a layer thickness of appr. 6 mm. During the application neither primer nor bonding agent is required. After total curing of MM-Elastomer the aluminium sheet was bended in an angle of 90°. The MM-Elastomer still stuck with the complete base on the facing side of the aluminium sheet. This is a sign for the excellent bonding properties of MM-Elastomer.

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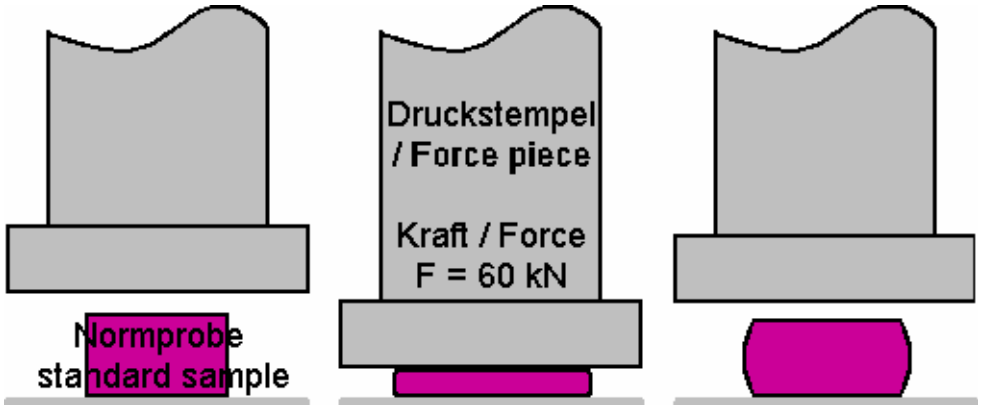
Technical Report PolymerMetal®

TEC-# 015
Compression strain test

Used products
MM-Elastomer



Description
As you can learn from this test, MM-Elastomer disposes high impact strength, hardness and low distortion rest despite of this high use. Furthermore no cracks or excavations could be found after the test. MM-Elastomer is especially suitable for the production of shock and vibration absorbers, cyclone coatings and for the repair of pumps, containers, seals and conveyor belts.

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Technical Report PolymerMetal®

TEC-# 017
Elimination of oil leaks from electrical devices like transformers, shunt reactors, transducers, etc.

Used products
MM-metal oL-steelceramic, MM-Elastomer

Introduction
The laws and requirements for environment protection determine, that no oil should leak out of the operating electrical machinery and plants. This demands that tightness of seams and flange connections are checked during inspections on regular basis. Power transformers are particularly vulnerable due to their construction, which has oil reservoirs, oil connections, large number of seams and age of the sealing material. By usage of cold curing PolymerMetals and MM-Elastomer a part of these oil leakages can be eliminated on the site itself.

Repair possibilities for PolymerMetals and MM-Elastomer

Transformers	Flange connections	Switches
Pumps	Shunt reactors	Condensers
Cables	Oil reservoirs	Cable boxes
Bushings	Transducers	Oil radiators

PolymerMetals
PolymerMetals are pasty, liquid or brushable materials, which are subjected to a special chemical process with the hardener (Polyaddition) right before processing. The polymers, which are a combination of resin, filler and additives, are processed in a specific way. By the mixing of the basis material and the hardener the PolymerMetals do totally cure and achieve properties similar to metal. The choice of the combining components dictates the final quality of the material and its characteristic profile.

When the repair of electrical devices is necessary often it can't be done by welding or soldering because of specific dangers of fire etc. More favourable and often only possible is a repair with PolymerMetals.

The liquidation of oil leakages at the repair site is possible, because a special PolymerMetal is applied to oily work pieces or work pieces contaminated by grease or petrol, where colour rests have been removed from. This PolymerMetal is not applied to a cleaned or prepared metal surface as common for most other materials. By applying the PolymerMetal that means working it up onto the metal surface an excellent bonding is reached.

Most important applications of PolymerMetals at electrical devices
- Sealing of oil leakages on seems under oil pressure (i.e. on transformers, shunt reactors, transducers, oil-radiators, oil-conservators)
- Sealing of air pressure leaks on seems (i.e. on compressed air lines, other compressed air equipment)
- Repair of bushings and ducts on mounting flanges
- Repair of oil filled frames (i.e. gearboxes, transducer frames)
- Repair of bushings for high voltage cables which are laid underground and display oil leakages

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- Repair of porcelain insulators with damaged parts
- Repair of coils

MM-Elastomer

The cold curing MM-Elastomer is a polyurethane based on polyisocyanate. This process helps to produce an oil resistant material from high grade polyurethane. Shortly before processing the pasty or liquid basis component is subjected to a chemical process (polyaddition) by adding a hardener. Hereby the MM-Elastomer does totally cure and acquires rubber like properties. The elasticity and abrasion resistance of MM-Elastomer (Shore A hardness = 95, 85, 65 or 40) can reach values better than conventional rubber. Whenever MM-Elastomer is used there is not necessary any primer. When subjected to elongation or compression, MM-Elastomer reverts back to its original shape and has a high electrical and chemical resistance. Basis of MM-Elastomer's multipurpose usage is the good bonding on rubber, metal and ceramics and sufficient bonding on pvc, polycarbo-nate, neoprene, fibreglass, glass, plywood and similar materials. The operating temperature of MM-Elastomer is limited to 130 °C (=266 °F).

Surface preparation

- Make the surface metallically clean and carriable
- Mechanically rough up the surface by sandblasting, cutting, grinding etc.
- Clean again by sweeping, blowing off, evaporating
- Thoroughly degrease with MM-Degreaser Z or do bind the oil with the PolymerMetal MM-metal oL-steelceramic
- When applying on rubber just mechanically rough up and clean the surface
- Apply a thin layer of MM-Release agent on surfaces, where a compound with the PolymerMetal should not be formed and polish after a short drying period

MM-Elastomer should be carefully mixed with the Hardener under consideration of the recommended mixing ratio and applied to the prepared surface. The exact application procedure will depend on the type and extent of the oil leak.

Repair methods

method1: There is slow oil leak from the seat of the damage, which reappears after about one hour of degreasing operation. In this case, repairs are done directly with MM-Elastomer after degreasing the seat of the oil leak. By the time the oil reappears at the leaky point again, the MM-Elastomer would have been cured enough to bond to the seat of damage. This type of repair is applicable to oil leaks between head and diverter-switch-vessel of a transformer. It should be considered that MM-Elastomer covers the sealing edges and overlaps the flanged edges as well.

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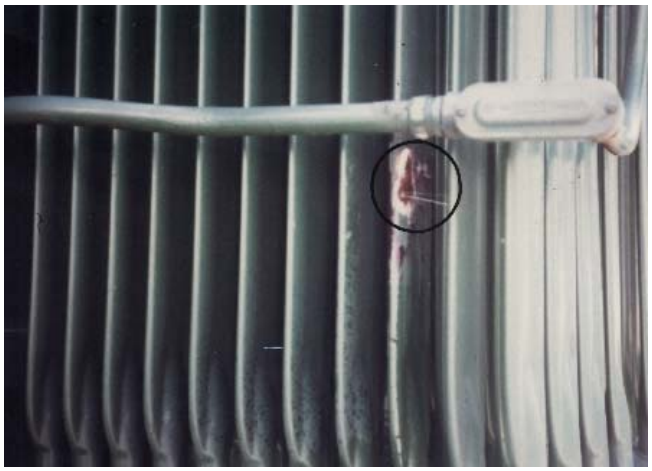
method2: This is a situation where oil pours out immediately or within a short period again after sweeping away from the leakage. This method should be chosen when the device is loaded by switching or vibration. First the oil must be binded with the PolymerMetal MM-metal oL-steelceramic. Then an overlapping coating with the cold hardening MM-Elastomer should be applied to the PolymerMetal.

method3: In this case an oil jet is coming out of the leakage. Here the repair site must be made pressure-free. This could be done by i.e. valving off the leakage, creating a vacuum at transformers, self tapping screws, calking, etc. If the leakage occurs at a position where there isn't enough surface i.e. at the edge of a heat exchanger, further assisting materials i.e. fabric tape should be used.



method4: Situations, where the damaged components are not subjected to vibration, or any other movements, oil leaks can be repaired by application of the PolymerMetal MM-metal oL-steelceramic alone.

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Summary
Main users in electric industry are big power plants, heating and power stations, electricity stations, substations, repair departments of the energy supply companies, electric railway stations and similar companies and service companies. PolymerMetals and MM-Elastomer are not electrically conductive and can therefore be used as protection against corrosion, too. After full curing they can normally be metal-cutted. Depending on the hardness of the used PolymerMetal there can be used Diamonds or SiC-grinding plates or normal tools.

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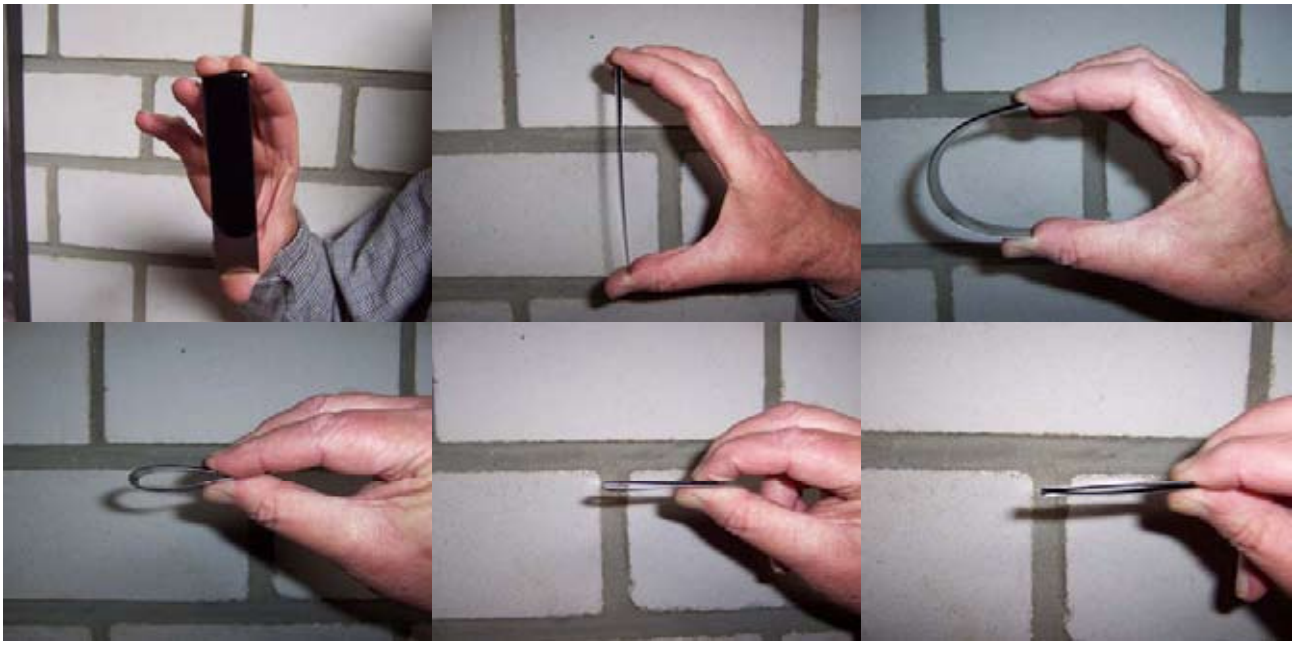
Technical Report PolymerMetal®

TEC-# 026
Adhesion & elasticity

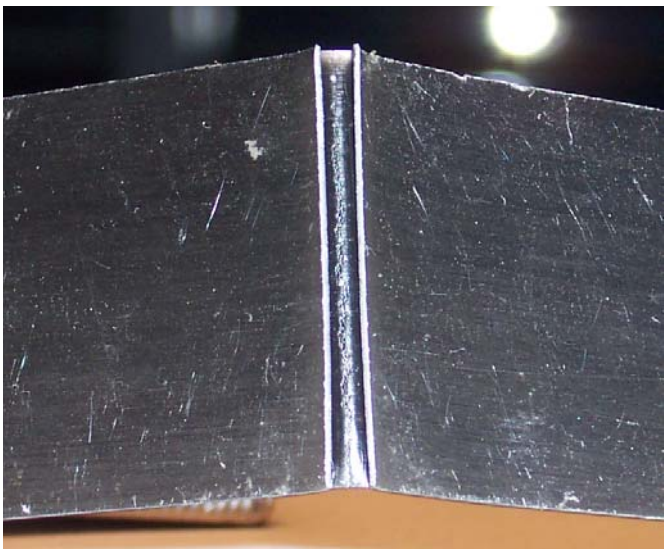
Used products
MM-Elastomer 95

Description
A flexible steel sheet with 0,3 mm thickness has been roughened up and degreased. Afterwards MM-Elastomer 95, liquid together with Hardener EL95 was applied to the sheet in a layer thickness of 2 mm. After full curing of the MM-Elastomer, the steel sheet was bended until it was broken.



Result
The test shows that the MM-Elastomer establishes an extremely good bonding with the metallic surface of the steel sheet even after the break of the sheet. Remarkable is that for the use of MM-Elastomer neither primer nor bonding agent is required.

The photograph on the right side shows a close-up of the bottom side of the steel sheet with the applied MM-Elastomer at the broken part of the sheet. You can see that the two broken sheet parts are still joined together by the MM-Elastomer.



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