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New Corrosion Resistant Material for better Performance

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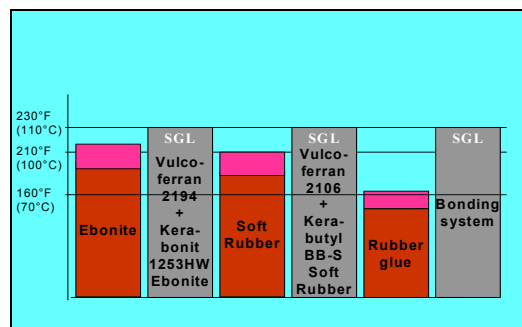
New Developments in Rubber Linings

- New rubber qualities for higher temperature and higher corrosion resistance
- Rubber seams made with hand extruder

Reliable Performance of P₂O₅ Evaporators

- Is graphite still the best solution for evaporators in few of corrosion resistance and life time

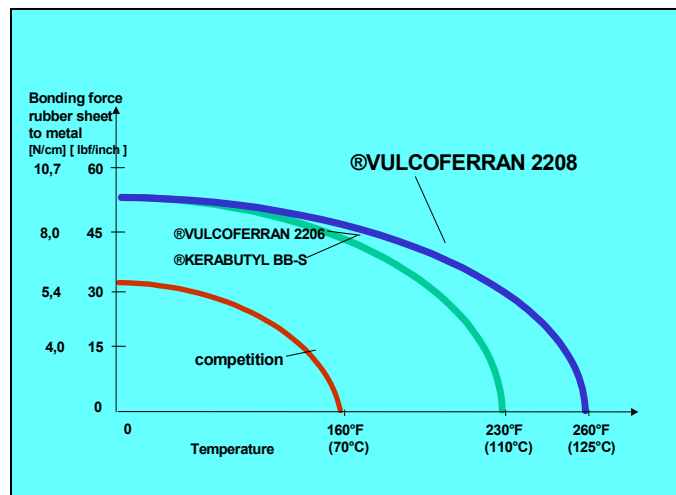
Present Temperature Limits



Objectives of the new material development

- Higher temperature resistance
- Good resistance against organics, nitric acid, hypochlorite
- Soft rubber and Ebonite suitable for site lining
- Bonding system of same material with same features
- Same material cost level as the existing rubber qualities
- Insensitive to temperature variation
- Material with high "Martens Point" (softening point)

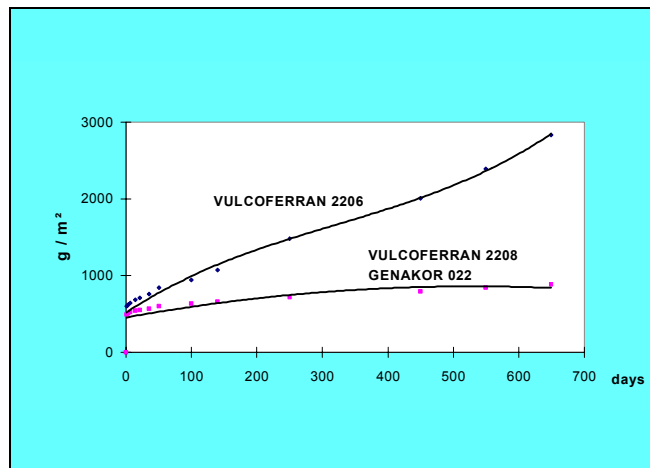
Soft Rubber



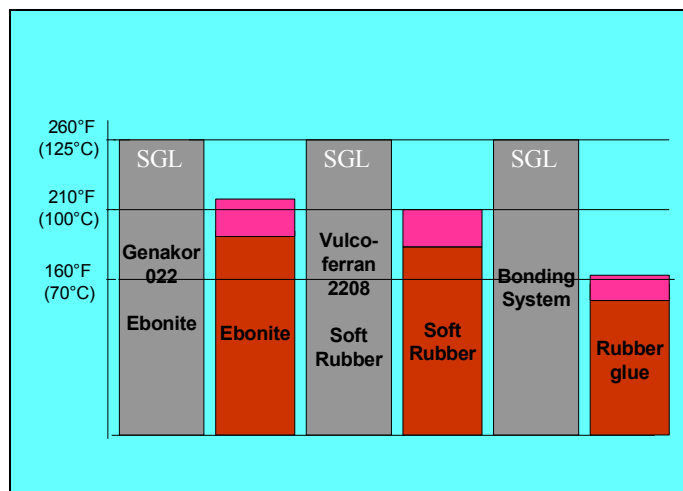
Physical Properties

Properties	Dimension	®Genakor 022 (IR) Ebonite	®Vulcoferran 2208 (BIIR) Soft rubber
Density	g/cc	1,40	1,19
Shore hardness		D 78 ± 5	A 70 ± 5
Tensile strength	psi	> 3.000	> 750
Elongation at brake	%	> 2	> 100
Bonding strength to steel	psi	1700	--
90 ° Stripping test	lbf/inch	--	60
Vulkanization temperature	°F	230	self vulcan./230
E-Modulus	psi	> 130.000	
Spark test (permissible)	kV/inch	No testing	75

Demineralized Water Test at 180 °F
Weight increase (g/m²) as function of time



New Temperature Limits



Extended corrosion Resistance

- Nitric Acid 20 % at 180 °F
- Hypochlorite up to 600 g per gal active Cl₂
- Organics: 2208: alcohol and organic acids
(no aromatic compounds or chlorinated hydrocarbons)
022: alcohol and organic acids
(traces of aromatic compounds or chlorinated hydrocarbons)
- Defoamers: 022: most of the defoamers resistant
2208: some of the defoamers resistant

Operating Experience

- Reactors for pigments: 022; 2 years (field lining)
(HCl + H₂SO₄ + pigments from 20 to 240 °F)
- Tanks for Uranium waste: 2208; 3 years (field lin.)
(HCl + H₂SO₄ + HNO₃ at 140 °F)
- Duct for waste gas: 2208; 3 years (field lining)
(acid mixture at 260 °F)
- Rail road cars: 2208 (shop lining)
Sodium hypochlorite with 600 g per gal Cl₂;
Hydrochloric acid up to 37 %
Caustic soda up to 50 %

New rubber material

®VULCOFERRAN 2208 and ® Genakor 022

Advantages and features:

- Improved corrosion and temperature resistance
- Soft rubber and Ebonite suitable for site and shop lining
- Bonding system of same material with same features
- Insensitive to temperature variation
- Extruded rubber sheets from 1/8 to 1/4 inch
- Material with high "Martens Point" (softening point)
- Same material cost level as the existing rubber qualities

Rubber seam extrusion

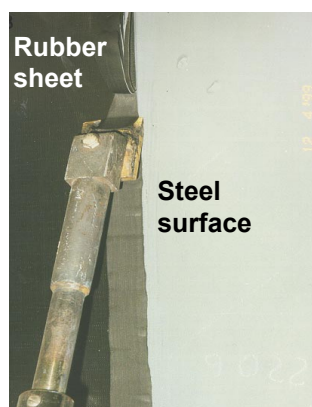
- (Patent-No. 198 14 376.1)1. Old technology of rubber joints
2. New development by rubber seam extrusion
3. Advantages and Features

Old technology of rubber joints

Fixing the first rubber sheet

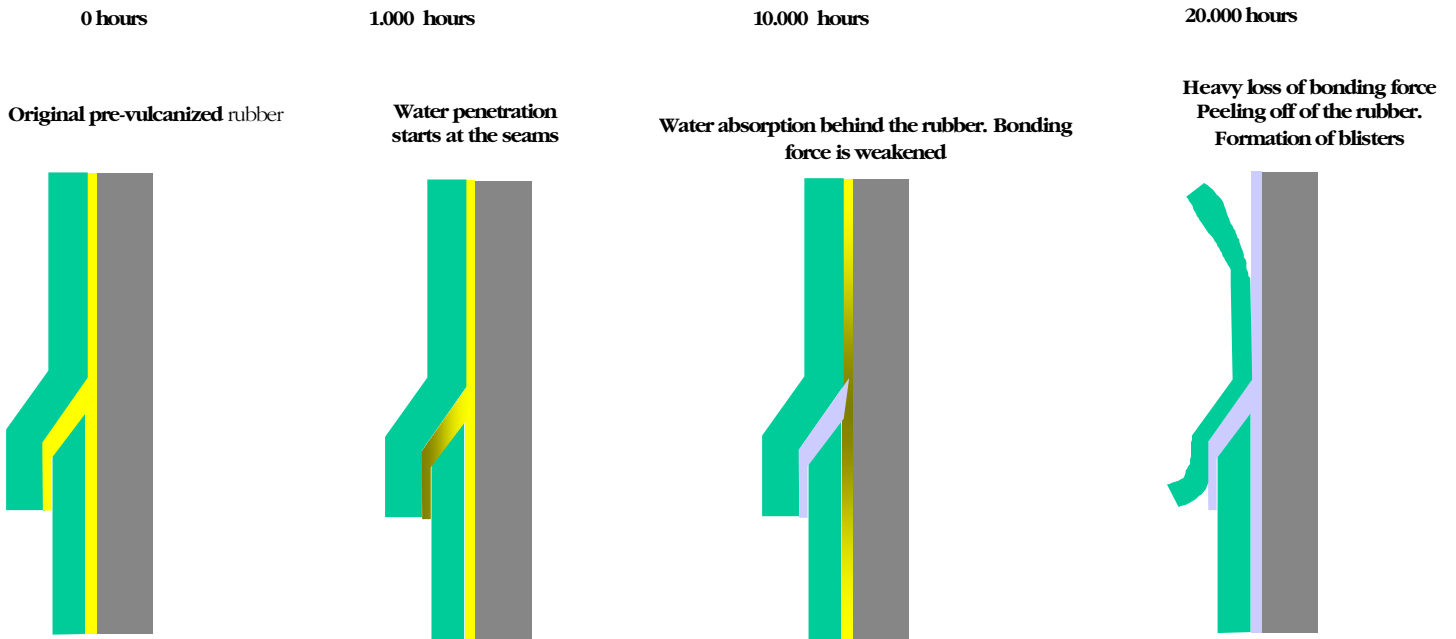


Bevel the edge

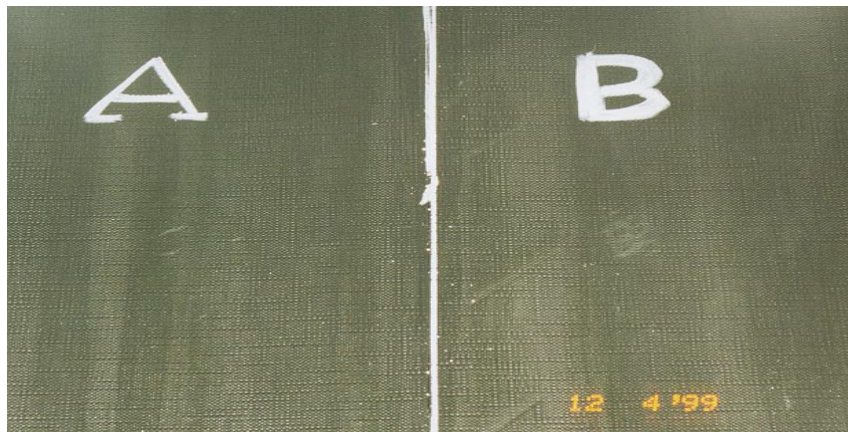


Design of the seams between the rubber sheets

The pre-vulcanized rubber is stuck to the steel with a polar glue.
This glue absorbs water that weakens the bonding greatly.



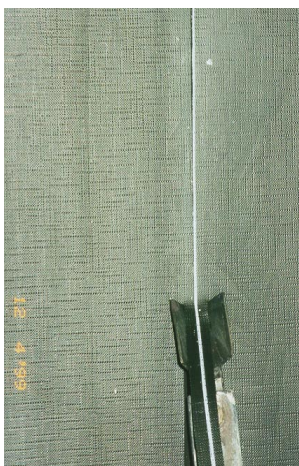
Seam extruder
Rubber sheets without seam preparation



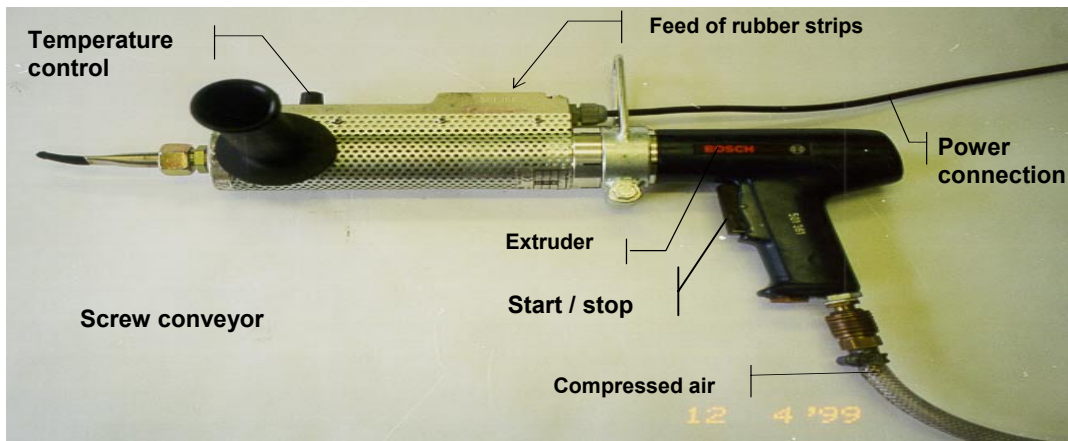
Rubber sheet

Rubber sheet

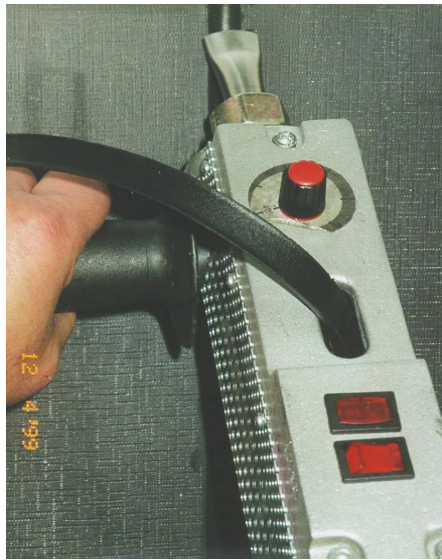
V-seam cutting



Hand extruder



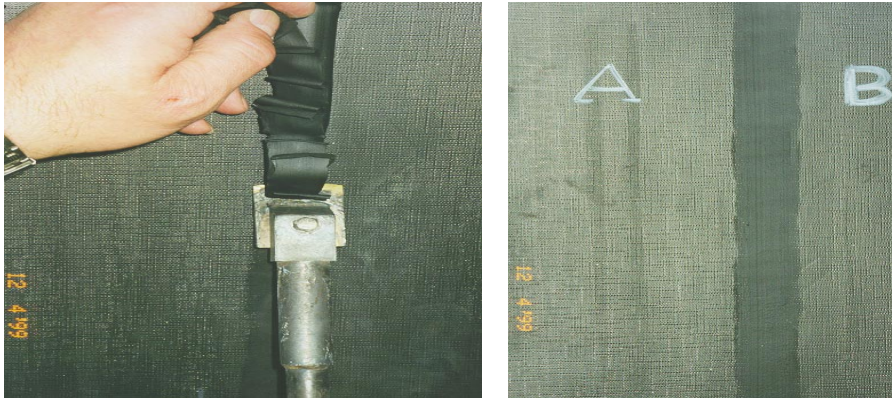
Rubber seam extrusion



Rubber seam



Option : rubber seam flattened



Seam extruder



Technical description:

- Rubber sheet material and extruded seam exactly the same
- Complete bonding of the seam material to the rubber sheet and the seam root to the steel
- Speed of seam adjustable up to 3 ft per minute
- Sheet material thickness from 1/8 to 1/4 inch
- Spark testing of seams possible

Advantages and Features:

- Rubber sheet material and seam of same quality without glue in between
- Seam can be controlled visually and by spark testing
- Same physical properties after vulcanization
- No liquid absorption of seam
- No cracks or opening in seam region
- Operational reliability
- Time saving in rubber application
- No expensive steel preparations in corners and complicated shapes
- Flattening of the seam possible for further application, like brick lining or assembly of internals
- No flow disturbance or scaling caused by the seam

- Suitable for small repairs of cracks in the lining material
- Economical and reliable technology

P₂O₅ evaporator

- Critical equipment for the concentration of phosphoric acid
- Material must be corrosion resistant
- The scaling in the tubes requires cleaning with chemicals or high water pressure
- The life time of the evaporator is essential for the operating costs
- Repair of the evaporator must be easy and cost effective

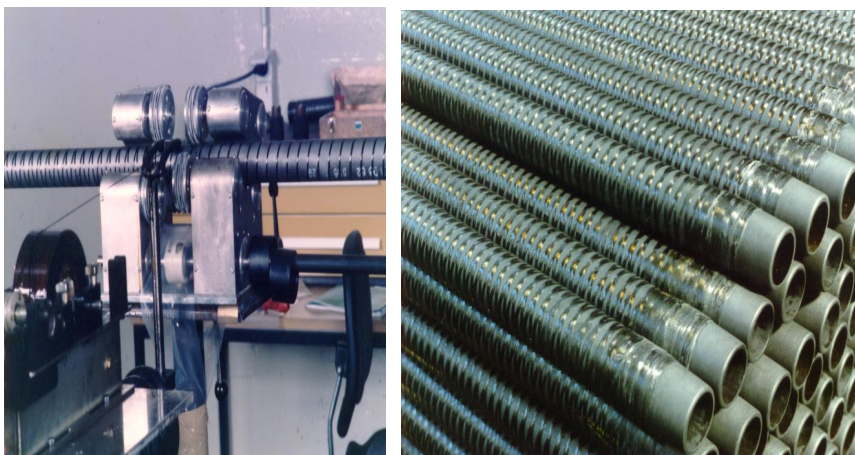
What is the better material choice ?
Graphite or Metal

DIABON tubes HF1 – Carbon fiber reinforced

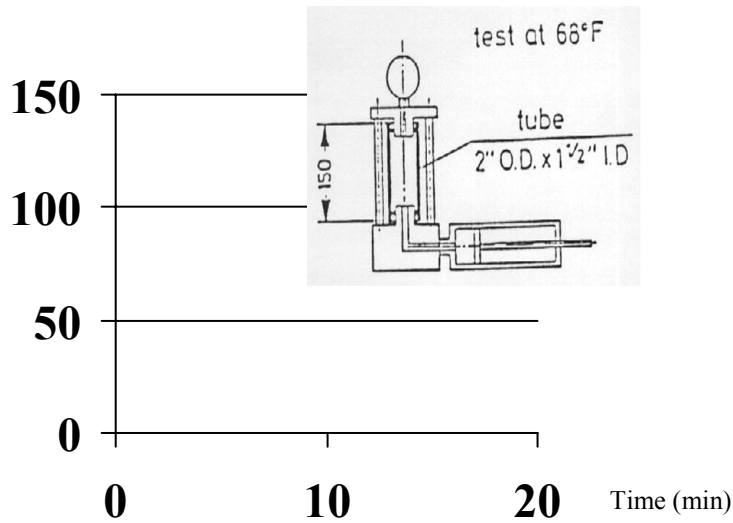


The carbon fibers keep the tube in compression and hold broken tube together, therefore averting catastrophic failure

DIABON HF1 – carbon fiber reinforced



Hydrostatic retention of HF1



A cracked HF1 tube can hold 40 psig pressure without leakage

DIABON tubes HF1 – carbon fiber reinforced



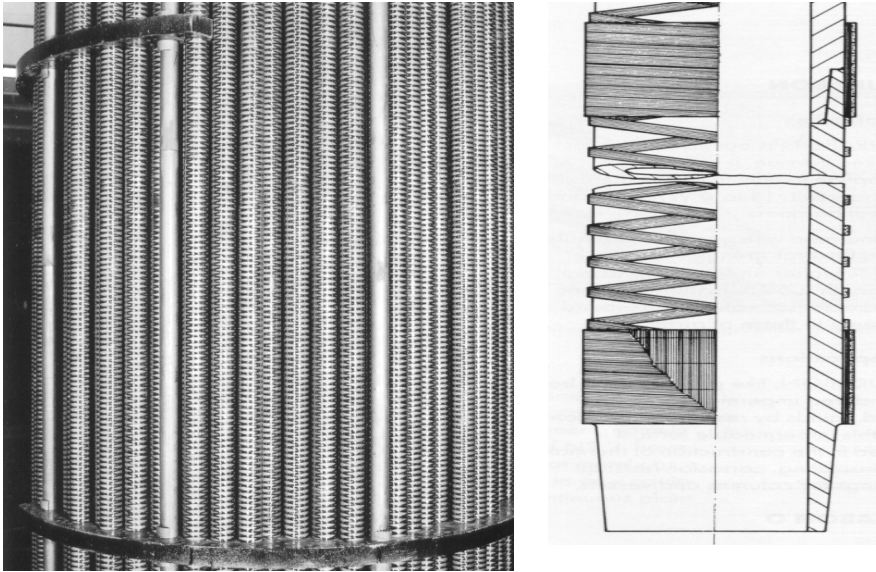
Features:

- 60 % higher bursting pressure compared to standard graphite tube
- 2,5 times higher resistance to steam hammer
- Same heat transfer duty as the evaporator with standard graphite tubes
- Same diameter and same pitch, therefore anytime replaceable with standard graphite tubes
- No shutdown of operation because of a cracked tube

Disadvantage:

- 10 to 15% higher investment costs of evaporator with carbon fiber wrapped tubes

® DIABON graphite evaporator for P₂O₅



SUMMARY

- Rubber sheets are a reliable material for corrosion and erosion protection for many decades
- The lining technology of rubber sheets shall be easy to apply for the applicators. The lining work can be tested to guarantee a long lifetime
- Evaporators made of graphite tubes remain a reliable and economical solution, the unique solution with fiber wrapped tubes improve the reliability
- The best corrosion solution of your plant can be offered and guaranteed from one source