

GEOFLUX PG

Antifreeze Concentrate for geothermal energy systems exempt ethylene glycol

Chemical composition:

Red tinted liquid based on propylene glycol, with anticorrosion additives, antifoam, biocides and antiscaling chemicals.

Product description:

Geoflux PG is a concentrate with antifreeze protection from -50°C to -5°C which is especially used as transfer medium in geothermal systems. **Geoflux PG** has been formulated with no toxic polyalcohol in order to avoid traditional glycol products toxicity.

Geoflux PG has excellent thermo-physics properties. The formula includes special additives in order to protect and increase the lifetime of the geothermal energy systems.

The outstanding properties of **Geoflux PG** are:

- **No corrosion of any part of the system.**
- **Protection against microorganisms, specially “*Legionella*”.**
- **Anti-scale additives to avoid calcium salt deposits.**
- **Reduce the Chemical Oxygen Demand in waste water.**
- **Avoid the bubble formation inside the circuit.**

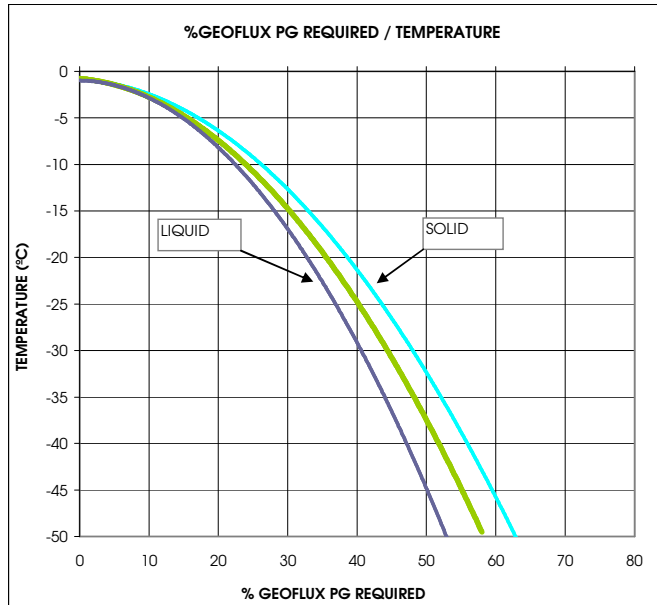
Physical properties:

PROPERTIES	VALUE	REGULATION
Aspect:	Red tinted Liquid	
Density (20°C)	1.05 kg/L	ASTM D1122
Viscosity (20°C)	49-50 cps	DIN 51562
pH (20°C)	7-9	ASTM D 1287
Alkaline reserve	>7	ASTM D 1121
Boiling point	<175°C	ASTM D 1120
Freezing Point	<-50 °C	ASTM D 1177
Water Content	10-14%	DIN 51 777

These data corresponds to average values in production, are not to be regarded as specifications.

Geoflux PG is a concentrated product and requires **DISTILLED WATER** addition to adjust the temperature conditions. Concentrations of **Geoflux PG** between 30% and 60% are highly recommended, in order to maintain optimal properties of the product.

The table below shows the relation between required temperature versus optimal percentage of **Geoflux PG**:



FREEZING TEMPERATURE (°C)	% VOLUME RECOMENDED (LITERS) GEOFLUX PG
0	0
-5	13
-10	23
-15	30
-20	36
-25	42
-30	45
-35	47
-40	52
-45	55
-50	58
GRAPHIC COLOUR	

Chemical properties:

Geoflux PG is a red tinted liquid based on propylene glycol, with specially formulated packages.

The additives pack has been enhanced with:

- Inhibitors based in Hybrid technology exempt of Nitrates and Nitrites which provide a durable protection against the corrosion and the degradation in both, metallic parts as well as parts of plastic or polymeric nature.
- Synthetic anti-scaling agents (to avoid the formation of any type of salt deposit).
- Biocides with the purpose to prevent “*Legionela*” development or any other microorganism formation

Geoflux PG guarantees a high and uniform performance of the geothermal energy system and assures the stability of all the mechanic systems in the circuit.

To preserve its specific properties, the product must not be mixed with another heat bearer fluid. The leaks of antifreeze must be refill exclusively with **Geoflux PG**.

Corrosion protection tests:

The tests were done based in the rule ASTM D 1384 (American Society for Testing and Materials). The following table shows the test results in g/m².

In the assay were included the following metals: copper, steel, aluminium.

Galvanic corrosion effects were also studied the in presence of **Geoflux PG** in the next combinations: copper - aluminium, copper - steel, steel – aluminium (Figure 1).

Disclaimer: Due to the large variety of factors which have an influence on the transformation and application of ours products, the provided information does not exempt the user of the responsibility in their own controls and assays. Also, our instructions don't represent a guarantee judicially connected in suitability for a specific use. It is responsibility of the recipient of our products observe the regulations and rules corresponding the present law.

The formulation of this additives is based in a hybrid technology in a rate Water:Antifreezing 66:34 % to accomplish with the limits in the rule ASTM D-1384.

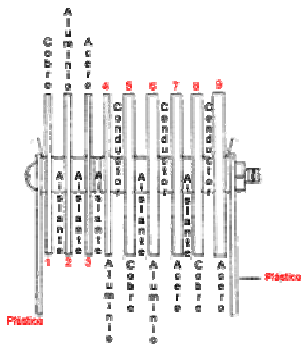


Figure 1: Metal disposition in the corrosion test. In 1st, 2nd and 3rd position we placed aluminium, steel and copper isolated, avoiding formation of galvanic pairs. In positions 4 and 5, we formed galvanic pairs Al-Cu; in positions 6 and 7 Al-Steel, and in positions 8 and 9 we formed the pair Cu-Steel.

Table 1 shows results of the anticorrosion tests. These tests have been done by LABCYP (“Laboratorio de Ensayos, Corrosión y Protección de la Universidad de Cádiz”).

Table 1: Anticorrosion results ASTM D 1384		
Material	Weight gain/loss Per surface unit	Corrosion rate (mm/year)
Copper	0.07 mg/cm ²	0.001 mm
Steel	-0.20 mg/cm ²	0.010 mm
Aluminium	0.03 mg/cm ²	-0.005 mm
Galvanic Pairs		
Copper- Aluminium	0.04 mg/cm ²	0.001 mm
Copper - Steel	0.05 mg/cm ²	0.002 mm
Aluminium - Steel	-0.04 mg/cm ²	-0.004 mm
Aluminium- Copper	-0.05 mg/cm ²	-0.005 mm
Steel - Copper	0.20 mg/cm ²	0.020 mm
Steel - Aluminium	0.20 mg/cm ²	0.020 mm

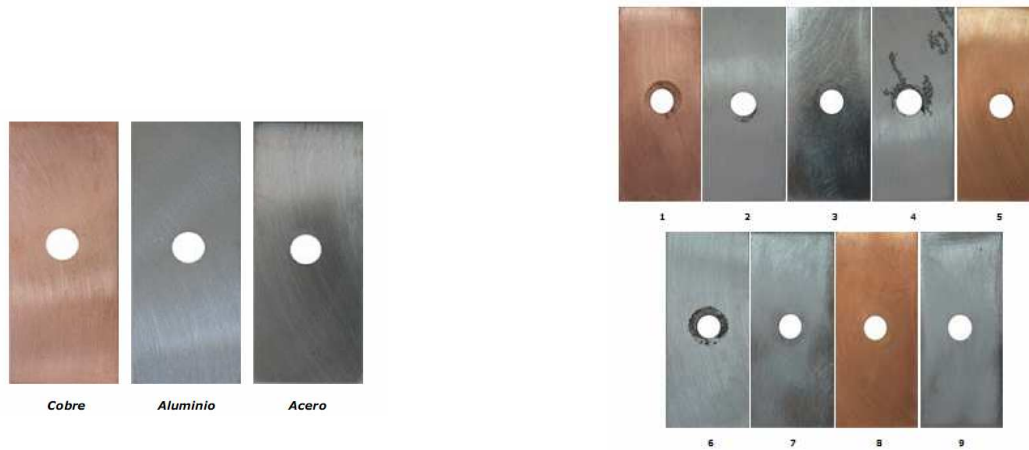


Figure 2: Samples of materials tested. Left: before corrosion test. Right: after corrosion test. Numbers correspond to those in **figure 1**.

Geoflux PG does not attack the rubber or plastic joints used in geothermal systems. The following information has been devised based in own tests in **Quimacer S.L.** and bibliography research.

Butyl rubber	IIR
Ethylene Propylene Diene Monomer rubber up to 140 °C	EPDM
Fluorocarbon Rubber	FPM
Natural rubber up to 85 °C	NR
Polyacetilenes	POM
Polybutadiene	PB
Polyethylene soft / hard	PE-LD, PE-HD
Crosslinked Polyethylene	PE-X
Polypropylene	PP
Polyvinyl chloride	PVC
Styrene Butadiene rubber up to 100 °C	SBR

Fenolic, ureic, soft Polyvinyl chloride and polyurethane rubbers are not resistant to chemical attack. We recommend a previous test with different materials. This is specially important when using rubber materials for expansion deposits according DIN 4807 regulation.

Additional recommendations:

With the finality to get the maximum efficiency and durability in the geothermal energy systems where **Geoflux PG** is going to be used, it can be recommended some advises:

- Geothermal systems must be closed systems to avoid the entrance of atmospheric oxygen.
- The installations must not contain heat exchangers, storage heater, deposits or galvanic tubes made with Zn because polyalcohol can dissolve the tin.
- **Geoflux PG** is an inert product. Because of the large variety of materials in this kind of systems (different manufacturers), it is completely necessary to be sure that the materials of the joints are resistant, according the manufacturer instructions when the fluid reach the maximum temperature.
- Small waste particles of copper formed during the system assembly must be removed completely from the circuit.
- Expansion containers must accomplish all requirements from DIN 4807 regulation.
- It is necessary that all the system is well isolated from electrical currents in order to minimize corrosion risk.
- It is important to check that the circuit is free from air. All cavities must be filled completely with **Geoflux PG**
- System losses must be filled only with **Geoflux PG**.

Packaging handling and storage:

Geoflux PG is available in plastic containers of 5, 10 and 25 litres, in drums of 60 and 120 litres. If the customer needs it is possible to supply in tanks of 1000 litres. The product keeps its properties for a period of 2 years if stored properly in its original packaging.

Handling:

Handle **Geoflux PG** following all safety rules and industrial hygiene (See the instructions of the security data sheet).

Geoflux PG is considered easily biodegradable. In case of small spills, there won't be any effect on the active sludge.

Quimacer S.L. has a Security data sheet accomplishing the directives of 91/155/CEE and 2001/58/CEE for **Geoflux PG**.