TECHNICAL DATA SHEET

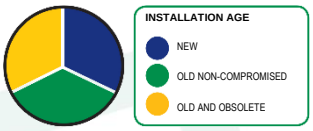
POLIKIL

Bacteriostatic sanitizer with anti-scaling and anticorrosive action for evaporative towers and closed cooling and air conditioning circuits summer-winter

Registered in Germany
Gemeldetes Biozid-Produkt Classe PT11

Adjuvant in the prevention of

Bacteria Legionella Moulds



DESCRIPTION:
Product with algaecide, anti-corrosive and anti-fouling function, specifically designed for the treatment of technical water in cooling systems, medium and large evaporative towers, operating both with totally softened aggressive water and with potentially encrusting hard water with total hardness up to 50 °f.

APPLICATIONS:
POLIKIL is a concentrated formulation that can be used in all closed and open tower recirculation systems operating with water with the following characteristics:

- $7.0 \leq pH \leq 9.2$
- Maximum hardness 50 °f

BACTERICIDAL ACTION:
DBNPA (dibromo-nitrilopropionamide), the active ingredient in POLIKIL, has exceptional bactericidal properties: it interacts rapidly with proteins inside the cell (inhibition of macromolecular synthesis - bacteriostatic effect); this growth inhibition quickly becomes irreversible with subsequent cell death (bactericidal effect).

Even before cell death, organisms treated with POLIKIL are unable to synthesise either the biodegradative enzymes or the exopolymers that facilitate biofilm formation. DBNPA is active against both prokaryotic (bacteria) and eukaryotic (fungi and algae) organisms.

ANTI-PRECIPITATING ACTION:
In POLIKIL, the anti-precipitating and anti-corrosive action is provided by the mixture of polyphosphonate and PBTC (1,2,4-tricarboxylic acid 2-phosphonobutane).

The anti-precipitating action occurs by three main mechanisms:

(a) threshold effect

Sub-metric quantities of these additives are able to effectively inhibit the precipitation of insoluble salts, in particular calcium and magnesium salts and many other metal cations.

CHEMICAL AND TECHNICAL PRODUCTS
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CHEMISTRY IN ACTION

(b) crystal distortion

These compounds are adsorbed on the active centres of the crystalline nucleus, causing a distortion and modification of its lattice.
The result is an inhibition of the normal growth of the crystal, which is therefore weaker and has little or no ability to adhere to the heat transfer surfaces.

(c) binding action

POLIKIL is capable of forming complexes with polyvalent metal ions.
The value of the stability constants gives an indication of the amount of unbound metal ion in solution; the larger the value, the smaller the amount of free ion.

The table shows the values of the logarithm of the stability constant of the complexes formed by POLIKIL with certain metal ions:

METAL	POLIKIL
	Log K_{ML}
Ca^{2+}	7,5
Mg^{2+}	7,2
Fe^{3+}	16,2
Ni^{2+}	11,1
Zn^{2+}	16,4

Where KML is the stability constant of the ML complex (generic metal M and generic binder L). So the higher the value in the table, the greater the stability of the complex, and the lower the free metal in solution.

DIRECTIONS FOR USE:
It is recommended that POLIKIL be dosed at a concentration of at least 90 to 100 ppm on system refill, while ensuring that a concentration of at least 140 to 150 ppm is maintained in the circulation.

This concentration can be reached by evaporation and the resulting concentration of dissolved salts in the circulating water.

In the case of very hard water where excessive concentration is not possible, the required amount should be dosed on refill.

TECHNICAL DATA:

Physical state	clear liquid
pH	< 2.5
Shelf – life	1 year at room temperature
Active ingredients	mixture of polyphosphonic acid / 1,2,4-tricarboxylic acid 2-phosphonobutane (PBTC) / 2,2-dibromo-3-nitril-propionamide (DBNPA)

CALCIUM SENSITIVITY:
A unique property of POLIKIL is provided by the phosphonates in its formulation which, unlike traditional products, while retaining all the characteristics of the family, also add calcium tolerance.
Traditional phosphonates are known to have solubility problems in water containing high concentrations of calcium ions; this effect is called calcium sensitivity.
Increases in pH value and hardness concentration strongly penalise the tolerance of phosphonate to calcium, increasing the possibility of precipitation of a poorly soluble Ca+ salt – inhibitor.
Under normal operating conditions, the ratio between the molar quantities of precipitant and phosphonate is always very high, but there is always a limit to this concentration ratio.

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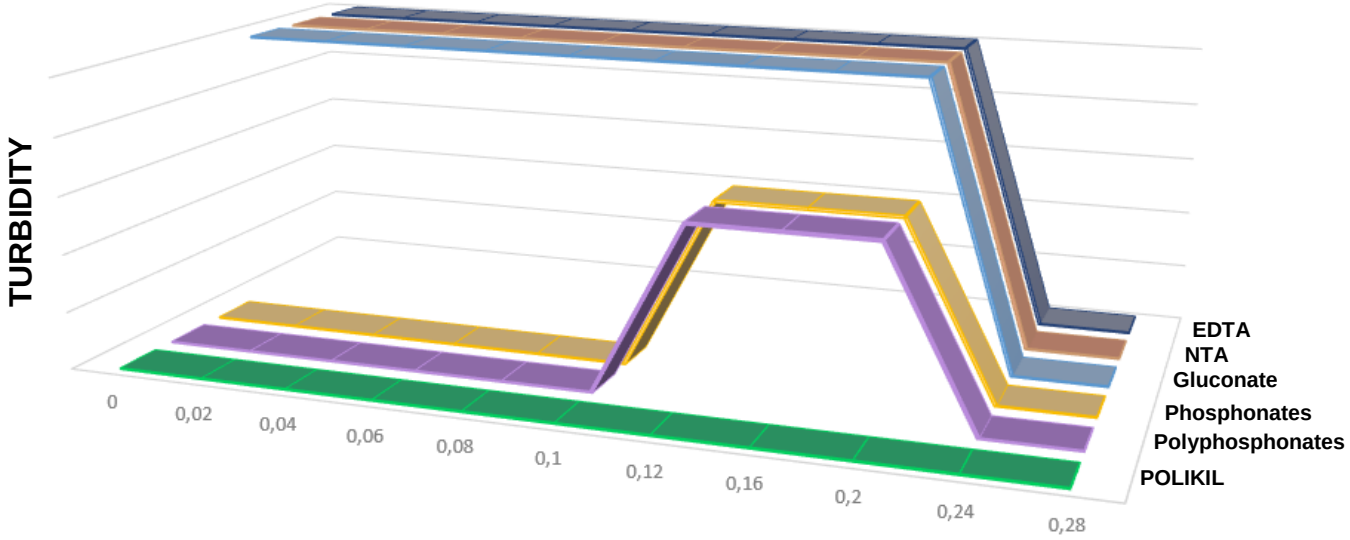
In this concentration zone, known as the 'turbidity zone', the phosphonate is withdrawn from the system and no longer acts; the effectiveness of the POLIKIL product at various metal:phosphonate ratios is schematically described in the figure below:

THRESHOLD EFFECT



INHIBITOR/METAL MOLE RATIO

In the graph, which compares well-known anticorrosive/antiscaling substances, it can be seen that there is no turbidity zone for POLIKIL, so there are no limiting concentrations of hardness or problems with overdosing the product: its behaviour is similar to that typical of acrylic or maleic polymers.

The corrosion-inhibiting action is carried out by the phosphonate mixture and has been verified through electrochemical studies (potentiostatic method). In these, a mild steel electrode, subjected to a cathodic potential of - 800 mV, rotates in a conducting solution.

The phosphonate, or mixture of phosphonates, under test is added to the system and the resulting change in current density is measured. The lower the final value of the current density, the more effective the substance is as a cathodic corrosion inhibitor.

The test was also extended to the HEDP/zinc mixture and the results are shown in the table:

ADDITIVO	Calcium hardness (ppm $CaCO_3$)	Final density of Current ($\mu A/cm^2$)	% inhibition
White	500	377	//
HEDP	500	52	86.2
PBTC	500	91	75.8
HEDP/PBTC	500	22	94.1
POLIKIL	**500**	**18**	**95.2**
HEDP/Zn	500	11	97

The substances compared, which are corrosion inhibitors with an anti-scaling function, are HEDP (1-hydroxyethane 1,1-diphosphonic acid), PBTC (1,2,4-tricarboxylic acid 2-phosphonobutane), their HEDP/PBTC mixture, POLIKIL and the HEDP/zinc mixture.

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It is immediately apparent that the addition of phosphonate drastically reduces the current density and, therefore, the corrosion rate of the system; the order of effectiveness is as follows:

POLIKIL > HEDP/PBTC >> HEDP > PBTC

It can also be seen that the performance of POLIKIL and HEDP/PBTC is comparable to that of zinc/phosphonate mixtures, but with the advantage of greater application flexibility.

PACKAGING:
Article code POLIKILK005, 5 l canisters, boxes of 4 pcs.
Article code POLIKILK025, 25 l canisters, boxes of 1 pc.
Article code POLIKILK200, 200 kg canisters, boxes of 1 pc.

CERTIFICATIONS AND REGISTRATIONS:

- **BAuA No. 98763**
  Biocidal product class PT11 *Preservatives for liquids in cooling systems and industrial treatment*

www.baua.de/DE/Biozid-Meldeverordnung/Offen/offen.html

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