ACUMER™ 4161 Phosphinopolycarboxylic Acid Scale Inhibitor and Dispersant

Description

ACUMER™ 4161 (PCA) polymer combines features of both phosphonates and polyacrylates to deliver a unique balance of threshold inhibition and dispersancy. This product is resistant to chlorine and compatible with most microbiological control agents.

Benefits of ACUMER™ 4161 (PCA) Polymer

Application	Benefits
Boiler Water	• Effectively disperses boiler sludge components. • Excellent hydrothermal stability. • Compatible with commonly used boiler additives.
Cooling Water	• Good scale control agent for calcium carbonate and calcium sulfate. • Effectively disperses particulate matter such as silt and clay. • Eliminates the need for phosphonates and acrylates in many formulations. • Effective in alkaline systems and under severe service conditions.
Pulp and Paper	• Good scale control agent for calcium carbonate and calcium sulfate. • Performance equal to or better than many phosphonates and acrylates. • Effective in both acid and alkaline papermaking systems.

U.S. Food and Drug Administration (FDA) Clearances

Regulation	Title
21 CFR 173.310	Boiler Water Additives
21 CFR 176.170	Components of Paper and Paperboard in Contact with Aqueous and Fatty Foods([1,2])
21 CFR 176.180	Components of Paper and Paperboard in Contact with Dry Food

[1] Only as the sodium salt.
[2] Only as: (a) a pigment dispersant in coatings at a level not to exceed 0.25% by weight of pigment.
(b) a thickening agent for natural rubber latex coatings, provided it is used at a level not to exceed 2% by weight of total coating solids.

Typical Properties

ACUMER™ 4161 (PCA) is supplied as a partially neutralized aqueous solution. Typical physical properties are listed below.

(These properties are typical but do not constitute specifications)

Property	Typical Values
Appearance	Clear to slightly hazy liquid
Total Solids, %	51
Active Solids, %	47
pH	3.3
Molecular Weight1	3600
Specific Gravity	1.22
Density, lb/gal @ 25°C	10.2
Brookfield Viscosity (mPa.s/cps @ 25°C)	500-2000

[1]Measured by aqueous GPC and reported as acid form.

Mechanism of Action

ACUMER™ 4161 (PCA) polymer can be used to inhibit scale buildup on surfaces through at least three mechanisms:

- Solubility enhancement or threshold effect, which reduces precipitation of low solubility inorganic salts.
- Crystal modification, which deforms the growing organic salt crystals to give small, irregular, readily fractured crystals that do not adhere well to surfaces.
- Dispersing activity, which prevents precipitated crystals or other inorganic particles from agglomerating and depositing on surfaces.

Low molecular weight polymers are widely used to inhibit scaling in industrial water treatment. The activity of ACUMER 4161 polymer in boiler water, cooling water and pulp and paper applications is illustrated in the following applications data.

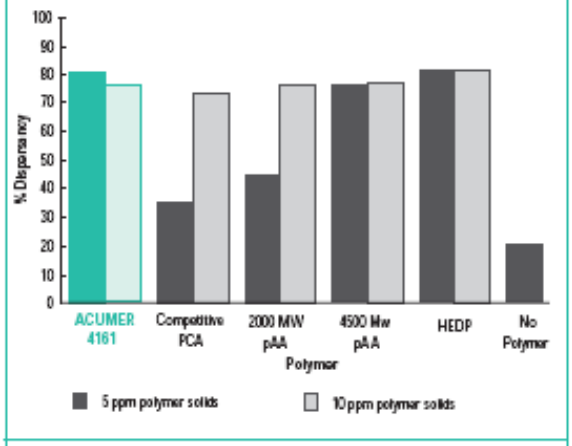
Applications

Boiler Water

Sludge Dispersancy

Laboratory testing of ACUMER™ 4161 (PCA) polymer has demonstrated excellent control of boiler sludge, with effective performance compared to traditional chemistries using polyacrylates, phosphonates and competitive products utilizing phosphinopolycarboxylic acids. Figure 1 shows the performance of ACUMER 4161 in boiler sludge dispersancy tests.

FIGURE 1
BOILER SLUDGE DISPERSANCY



Conditions:

57 ppm Ca, as $CaCO_3$
41 ppm Mg, as $CaCO_3$
376 ppm M-Alkalinity, as $CaCO_3$
78 ppm PO_4, as PO_4
16 ppm Iron, as Fe^{+3}
28 ppm silicate, as SiO_2
pH 10.5
1-hour settling time

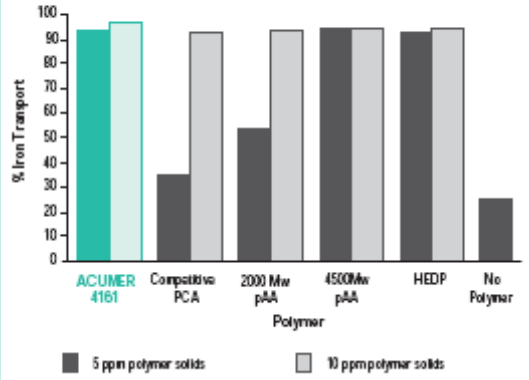
Measure turbidity of top 20 ml of 100 ml sample

$$\% \text{ Dispersancy} = \frac{\text{turbidity of sample}}{\text{turbidity of shaken control}} \times 100$$

Iron Transport

ACUMER 4161 (PCA) polymer makes it possible to easily transport iron with calcium, phosphate and silicate containing sludges for removal during blowdown. Figure 2 (opposite) demonstrates the ability of ACUMER 4161 to transport iron.

FIGURE 2
IRON TRANSPORT



Conditions:

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41 ppm Mg, as $CaCO_3$
376 ppm M-Alkalinity, as $CaCO_3$
78 ppm PO_4, as PO_4
16 ppm Iron, as Fe^{+3}
28 ppm silicate, as SiO_2
pH 10.5
1-hour settling time

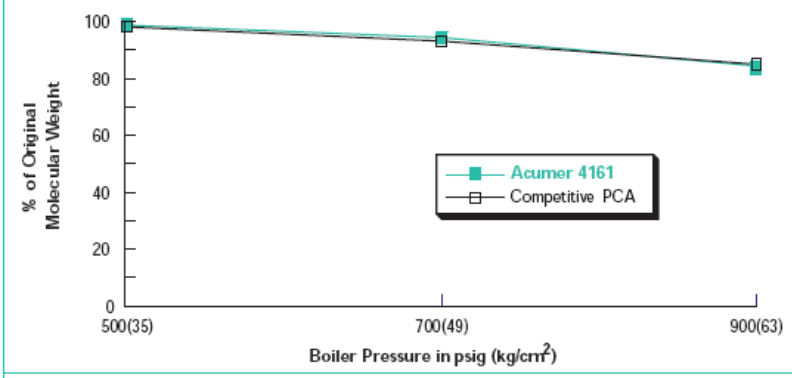
Measure Fe in top 20 ml of 100 ml sample

$$\% \text{ Iron Transport} = \frac{\text{total Fe in sample}}{\text{soluble Fe charged}} \times 100$$

High-Temperature Stability

ACUMER 4161 (PCA) polymer is stable at high pressures and temperatures typical of those found in industrial boilers, up to at least 900 psig. Figure 3 (below) contains a profile of the hydrothermal stability of ACUMER 4161.

FIGURE 3
HYDROTHERMAL STABILITY



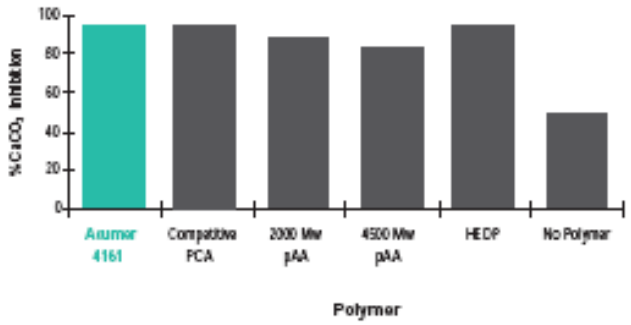
Conditions:
Pressure bomb
5000 ppm polymer actives
pH 10.0, 24 hours
N_2 sparge and sodium sulfite oxygen scavenger
468°F (500 psig), 504°F (700 psig), 532°F (900 psig)

Cooling Water

Calcium Carbonate Inhibition

Under high pH and alkalinity conditions, calcium carbonate scale formation is a potential problem that can be prevented by threshold inhibition. Figure 4 (below) shows that at 7 ppm polymer solids the performance of ACUMER 4161 (PCA) polymer is equivalent to HEDP (1-hydroxy-ethylidene-1, 1-diphosphonic acid) and a competive PCA, and more effective than polyacrylic acid chemistries.

FIGURE 4
CALCIUM CARBONATE INHIBITION
7 ppm Polymer Solids



Conditions:
636 ppm Ca, as $CaCO_3$
318 ppm Mg, as $CaCO_3$
636 ppm M-Alkalinity, as $CaCO_3$
54°C, 20 hours
pH 9.0

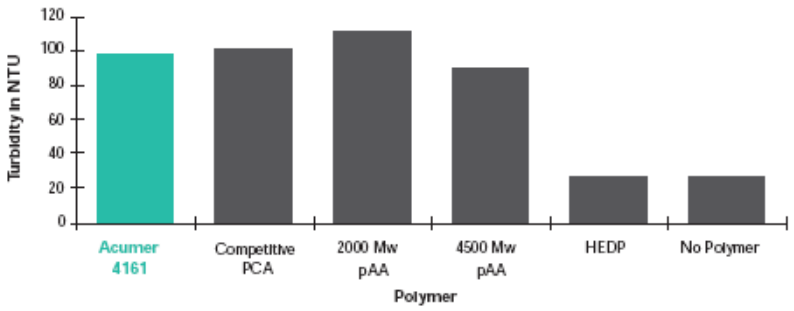
$$\% \ CaCO_3 \ Inhibition = \frac{[Ca^{+2}] \ sample}{[Ca^{+2}] \ initial} \times 100$$

Dispersing Activity

Industrial cooling water contains particulate matter such as silt, clays and calcium-based precipitates. The particles can deposit on heat transfer surfaces and produce excessive sediment in regions of low water velocity.

Kaolin clay was used to represent particles commonly found in many waters. At low polymer levels (6 ppm) ACUMER 4161 (PCA) polymer has kaolin clay dispersancy equivalent to a competitive PCA and polyacrylic acid polymers. Figure 5 demonstrates the performance of ACUMER 4161 dispersant.

FIGURE 5
KAOLIN DISPERSANCY
6 ppm Polymer



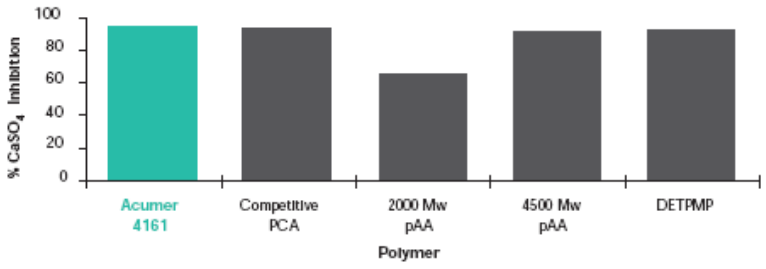
Conditions:
1000 ppm Hydrite UF kaolin
200 ppm Ca as $CaCO_3$
pH 7.5
2-hour settling time, then measure turbidity of top 20 ml of 100 ml sample

Pulp and Paper

Calcium Sulfate Inhibition

ACUMER 4161 (PCA) polymer effectively inhibits calcium sulfate precipitation. Figure 6 shows performance compared to polyacrylic acids, a competitive PCA, and a phosphonate (DETPMP–diethylenetriamine pentamethylene phosphonate).

FIGURE 6
CALCIUM SULFATE INHIBITION
5 ppm Polymer Solids



Conditions:
3778 ppm Ca, as $CaCO_3$
3756 ppm SO_4, as $CaCO_3$
pH 8.3
70°C, 24 hours

$$\%\ CaSO_4\ \text{Inhibition} = \frac{[Ca^{+2}]\ \text{sample} - [Ca^{+2}]\ \text{blank}}{[Ca^{+2}]\ \text{initial} - [Ca^{+2}]\ \text{blank}} \times 100$$

General Product Handling

ACUMER™ 4161 (PCA) polymer can develop a slightly hazy appearance after long-term cold storage. This change in appearance is due to intramolecular hydrogen bonding and does not impair performance. Hazy product can be cleared up by warming it to 60°C or by diluting the polymer to <30% solids. Freezing or long-term cold storage of ACUMER polymers can cause separation of the components. Although product performance is not impaired, it is recommended that ACUMER polymers not be frozen in order to avoid the need to remix the product.

ISO 9002 Certification

All ACUMER™ products are produced in an ISO 9002-certified manufacturing facility.

Handling Precautions

Before using this product, consult the Material Safety Data Sheet (MSDS)/Safety Data Sheet (SDS) for details on product hazards, recommended handling precautions and product storage.

Storage

Store products in tightly closed original containers at temperatures recommended on the product label.

Disposal Considerations

Dispose in accordance with all local, state (provincial) and federal regulations. Empty containers may contain hazardous residues. This material and its container must be disposed in a safe and legal manner.

It is the user's responsibility to verify that treatment and disposal procedures comply with local, state (provincial) and federal regulations. Contact your Dow Technical Representative for more information.

Product Stewardship

Dow has a fundamental concern for all who make, distribute, and use its products, and for the environment in which we live. This concern is the basis for our product stewardship philosophy by which we assess the safety, health, and environmental information on our products and then take appropriate steps to protect employee and public health and our environment. The success of our product stewardship program rests with each and every individual involved with Dow products - from the initial concept and research, to manufacture, use, sale, disposal, and recycle of each product.

Customer Notice

Dow strongly encourages its customers to review both their manufacturing processes and their applications of Dow products from the standpoint of human health and environmental quality to ensure that Dow products are not used in ways for which they are not intended or tested. Dow personnel are available to answer your questions and to provide reasonable technical support. Dow product literature, including safety data sheets, should be consulted prior to use of Dow products. Current safety data sheets are available from Dow.

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