



**Drew Marine**

## **DREWPLEX® Boiler Water Treatments** Revolutionary Protection for Your Vessel's Steam-Generating System

### **DREWPLEX AT Boiler Water Treatment**

. . . the first insurance against the costs of feedwater upsets

### **DREWPLEX OX Corrosion Inhibitor**

. . . superior, non-hazardous corrosion control



**ASHLAND**  
ASHLAND SPECIALTY CHEMICAL COMPANY

## Challenges from a Changing World

Technological leadership demands more than superior technology. In the marine industry, it also requires an insider's understanding of shipboard operations—and the ability to recognize and respond creatively to changing needs. That powerful combination of resources, expertise and insight has made the Drew Marine Division of Ashland Specialty Chemical Company the undisputed leader in water treatment technology for more than half a century.

Maintaining low-pressure exhaust gas economizers and auxiliary boilers in good condition became vastly easier and more efficient in 1975 when Drew Marine introduced the industry's first one-drum, multi-system water treatment. This phosphate-based program proved very effective for preventing heat-reducing scale on boiler steam-generating surfaces. And with hydrazine, a powerful oxygen scavenger, wrapped into the same formulation, it also reduced system corrosion dramatically. The convenience of all-in-one dosing ensured universal acceptance by motor vessel operators, and with widespread imitation this program quickly became the industry standard.

More than 20 years later, one-drum treatments continue to provide exceptional performance under conditions where feedwater quality is good and predictable—they work very well at preserving that quality.

However, the ability to maintain these controlled conditions is becoming increasingly rare. With heavy demands on limited crew and vessel operation, the modern shipboard reality is that feedwater quality variability and upsets are common. Inefficient evaporator function due to inadequate attention or treatment control typically causes elevated levels of hardness ions as a result of brine in the make-up water. And condensate contamination can come from numerous sources, including in-leakage of seawater at coolers and condensers, and of foreign substances at cargo hold heating coils. Conventional one-drum treatments cannot handle the excess hardness in the feedwater, and that results in scale and deposit formation on heat transfer surfaces.

The picture has also changed for the hydrazine component included in these all-in-one treatments. To satisfy the specifications of the leading marine boiler manufacturer, all dissolved oxygen must now be removed from the feedwater, and that requires concentrated dosing of the preboiler system with an oxygen scavenger. In addition, the listing of hydrazine as a carcinogen has raised health and safety issues that limit its suitability for long-term use.

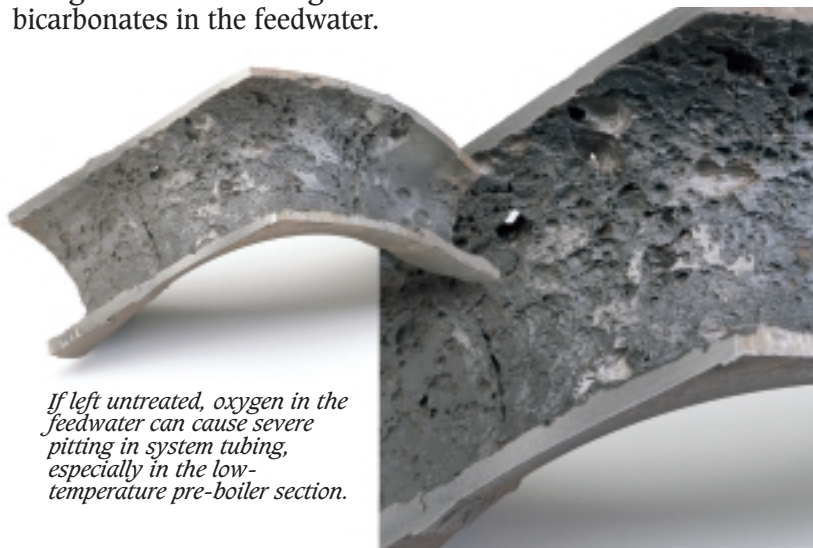


## The Case for Treating Boiler Water

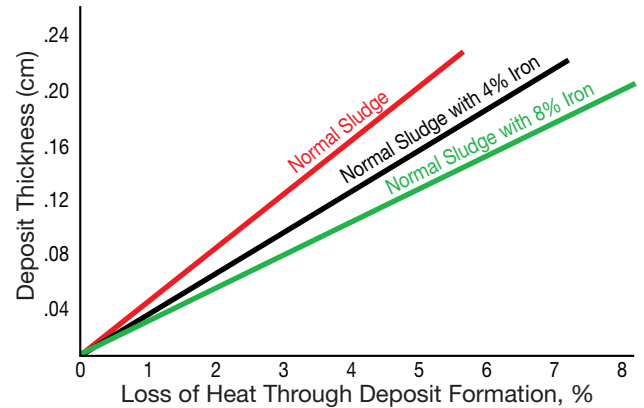
An effective program for monitoring and treating boiler water will keep your entire system running at peak efficiency. It will also help you minimize, or avoid completely, the costs of system problems. Both of these results represent gains for the economical operation of your vessel. The magnitude of those gains can best be appreciated by considering the costs and consequences of *not* treating your system.

Potential problems in untreated boiler systems, or inadequately treated systems, come from many sources:

- **Scale buildup** on boiler tubes results from dissolved and suspended solids. Hardness ions, primarily calcium and magnesium, in the feedwater can come from seawater, shore and potable water systems. Even a small amount will form objectionable scales.
- **Sludge deposits** on the tubes are usually caused by partly treated waterborne solids that have not been removed by system blowdown.
- **Metal oxide deposits** form from corrosion products—typically iron from the boiler or steam system in the form of ferric oxides, and copper—returned from the condensate system.
- **Corrosion** in the system is caused principally by oxygen. Due to practical limitations on the ability to remove oxygen thermally and mechanically, through deaeration, there is always some oxygen in the feedwater. It is also introduced by in-leakage of air at low-pressure points, such as the suction side of pumps, and the condensers. Depending on the source of oxygen, system pressure and temperature, and water chemistry, the potential for corrosion affects all system sectors. (See schematic) The pre-boiler, where relatively low temperatures intensify the effects of the oxygen, is the most vulnerable. And areas that are intermittently wetted, such as the internal surfaces of deck piping and remote sections of the system, are also at high risk. In the condensate section of the after-boiler, additional corrosion effects can result from low pH acid attack. The source of the carbonic acid that causes this problem is carbon dioxide produced by the breakdown of organic matter and organic carbonates and bicarbonates in the feedwater.

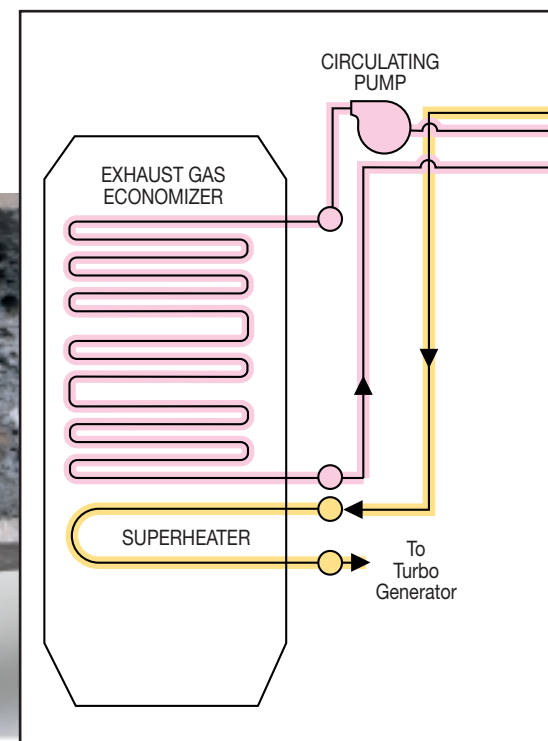


*If left untreated, oxygen in the feedwater can cause severe pitting in system tubing, especially in the low-temperature pre-boiler section.*



*Increasing accumulations of sludge deposits in boiler tubes mean larger reductions in heat transfer capacity and boiler efficiency—and scale build-up, shown above, has a comparable effect. Cleaning or replacing blocked tubes adds direct costs.*

## Chemical Feed Point Options



# The New Generation of Marine Water Treatment Technology Has Arrived!

The results of scale buildup and deposits, as well as the pitted metal surfaces caused by corrosion, are extremely costly. Reduced boiler efficiency is inevitable, along with a reduction in heat transfer capacity that can directly affect vessel services. And failure of the tubes means complete loss of services. There are significant labor, parts and downtime costs for replacement, as well as cleaning fouled tubes and removing scale accumulations.

The practice of relying on acid cleaning for periodic descaling as a substitute for controlling the scale with chemical treatment carries added costs. Vessels subjected to this method experience chronic heat transfer loss, which continues to build until the scale is removed, as well as unscheduled system outages. And hazardous acid-cleaning solutions require special handling by the operators and environmentally responsible disposal procedures.

The sum of these costs is a persuasive argument for pro-active water treatment. An important corollary is: the better the treatment, the greater the savings. And that is where the DREWPLEX® AT and OX dual-treatment program makes a difference that has real value.

## The Phenomenon of Polymers: Secret Weapon Against Boiler System Deposits

Synthetic polymer technology is the modern approach to boiler scale and deposit inhibition. Polymers are simply chains of organic molecules. Their superiority to the natural organic compounds used in earlier technology comes from their consistent molecular weight and composition, thermal stability, and resistance to carbonizing. Polymers were first introduced to shipboard use over 30 years ago in Drew Marine's AMEROYAL® evaporator treatments. To appreciate their benefits for steam-generating systems, it is useful to revisit the function of three components from earlier technology that have been preserved in DREWPLEX AT boiler water treatment.

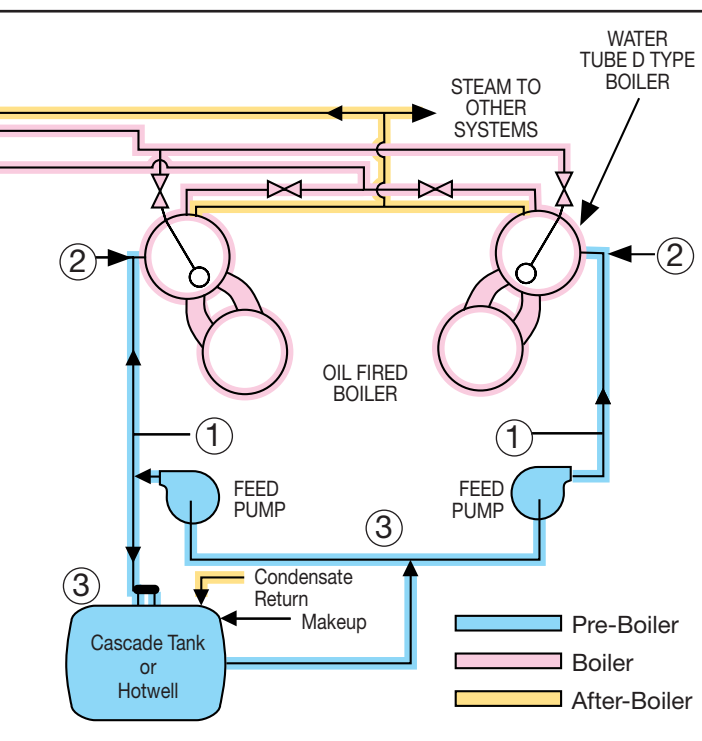
The role of *phosphate* is to react with hardness ions in the form of calcium. The formulation utilizes *hydroxide alkalinity*, which acts on the calcium phosphate, as well as magnesium, to form fluid, non-adherent sludges. These sludges are then easily removed from the system by bottom blowdown. In addition, special *neutralizing amines* in the formulation serve as after-boiler corrosion inhibitors that adjust and control pH by neutralizing acids, such as carbonic acid, throughout the condensate system.

Now we look at what synthetic polymers add to the picture. In a boiler system, these molecular chains perform several important functions:

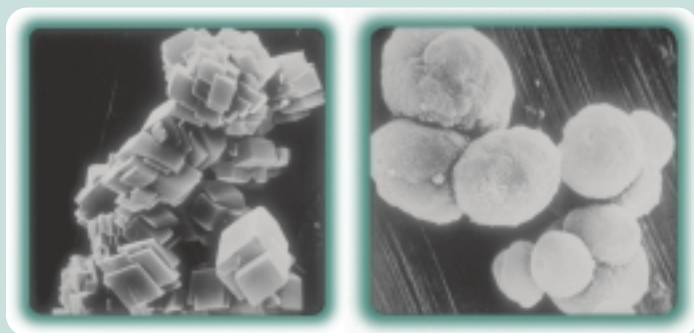
**Dispersion** — Polymers provide highly efficient dispersion of sludge particles, which keeps them moving freely through the system for easy removal by blowdown. They help keep the sludge in suspension by *adsorbing* on the particles. (*Adsorption* occurs when one substance is held to the surface of another substance as a result of a chemical attraction between the two.

*Absorption*, the more familiar term to many, means that one substance penetrates to the inner structure of another.)

- ① DREWPLEX OX-BWT Dosing System with Metering Pump (continuous)
- ② DREWPLEX AT-BWT Dosing System with Metering Pump (continuous)
- ③ Gravity Feed with Flowmeter – Not the preferred method (continuous)



The “secret” ingredients in our DREWPLEX® treatments are actually not so secret. In fact, the advanced components in each were originally developed for shoreside industrial applications, and have been thoroughly proven. Drew Marine’s ability to adapt these chemical “tools” to the unique needs of the motor vessel shipboard environment is what gives us the technical edge that translates to leadership.



Without treatment, the crystals formed by hardness ions form dense, hard scale as shown at left. The polymers in DREWPLEX AT boiler water treatment intervene with this process to produce the softer, non-adherent particles shown at right.

**Crystal modification** — By disrupting the shapes and growth patterns of crystals formed by hardness ions, polymers prevent the formation of dense hard scale. The end-product of crystal modification is smaller particles and soft, fluid, non-adherent materials.

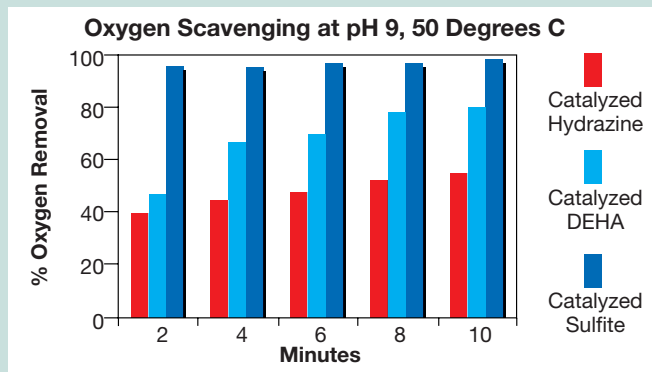
**Iron dispersancy** — Polymers also prevent the deposit of iron returned to the boiler from corrosion in the condensate system.

**Chelation** — This is *the Big Payoff!* The polymers serve as back-up scale inhibitors that supplement and reinforce the phosphate program. In this critical role, they act as a reserve agent for controlling deposits from *excess hardness* that may find its way into the system. When feedwater upsets or contaminant in-leakage result in more hardness ions than the available phosphate reserve can handle, the polymers react with the remaining calcium and magnesium ions to prevent hardness from precipitating and forming scale.

The bottom line is low-cost insurance against the high costs of feedwater “surprises.” DREWPLEX AT boiler water treatment provides unsurpassed multi-function performance for controlling scale and deposits. The proof is in the results: clean boilers, minimum downtime, low maintenance costs, and minimum need for acid cleanings.

## A Giant Leap Forward in Oxygen Scavenging Technology

The key ingredient in DREWPLEX OX corrosion inhibitor is DEHA (Diethylhydroxylamine), a volatile, non-carcinogenic, highly effective oxygen scavenger. Its application in the DREWPLEX program is a first for marine boilers. The DREWPLEX OX formulation, which also contains a catalyst, attacks corrosion on three fronts:



**Oxygen Scavenging** — The DEHA attaches to oxygen molecules to form a non-corrosive compound. The catalyst accelerates the rate of the oxygen-removal reaction, which improves corrosion protection, particularly in the vulnerable pre-boiler section.

**Volatility** — Introduced as a liquid, DREWPLEX OX treatment is easily volatilized into a gaseous state. In this state, the excess from feedwater—whatever is leftover from the scavenging mission in the pre-boiler—is carried efficiently through the boiler and out into the condensate system. This characteristic enables DREWPLEX OX corrosion inhibitor to protect the entire steam-generating and utilization system. It also means that the remedy does not contribute to the problem because no dissolved solids are produced.

**Passivation** — This function is important because it is virtually impossible to remove *all* dissolved oxygen from the condensate system. Shielding the base metal by passivation is the primary weapon for protecting that sector. Our treatment becomes a unique reducing agent—it reduces ferric ions to ferrous ions that create a passive oxide film called magnetite. This tightly bonded molecular layer acts as an efficient barrier between the corrosive condensate and the metal.

These powerful combined forces are a substantial benefit to the boiler system and its operators. Oxygen, and its corrosion threat, are virtually eliminated, and the amount of corrosion products, typically iron and copper oxides from the condensate system, entering the boiler is dramatically reduced. Major improvements in reliability, efficiency and service life are assured, along with substantial reductions in maintenance and downtime. Its unique properties also make DREWPLEX OX corrosion inhibitor very effective for protecting idle boilers during wet lay-up.

Unlike hydrazine, DEHA is not carcinogenic—so its health and safety benefits ensure the long-term utility of DREWPLEX OX corrosion inhibitor. Faster action because of its catalyst and more extensive penetration of the system because of its greater volatility are “extras” that guarantee an immediate advantage.

## Application Convenience and Control

Both products in the DREWPLEX® treatment program are formulated as liquids for easy mixing and feeding. The right dose for your boiler will depend in part on system capacity. It can vary according to the purity and quality of your condensate returns, and the quality and amount of makeup required by the system. Appropriate on-going system doses are determined by simple daily testing of key treatment parameters.

### Dosing

DREWPLEX AT boiler water treatment, which is intended for use only in *low-pressure systems* (up to 32 kg/cm<sup>2</sup>, or 450 psig), is fed continuously into the feedwater line using a metering pump. The initial dosage recommendation at start-up is normally 2.5 to 5 liters per tonne of water in the system. The typical daily dose is approximately 1.0 liter, and will vary according to the operational demands on your system.

For *low and medium-pressure systems* (up to 60 kg/cm<sup>2</sup>, or 850 psig) with feedwater recirculation, DREWPLEX OX corrosion inhibitor is dosed downstream of the feedwater recirculation offtake. If there is no feedwater recirculation, the most effective feed points are at the feed pump suction, or into the condensate return atmospheric drain tank or hotwell. Continuous dosing is advised for best results with all oxygen scavenger applications.

Either the storage section of the deaerator or the feed pump suction is the preferred location for dosing DREWPLEX OX treatment to *high-pressure systems* (60 kg/cm<sup>2</sup> or 850 psig and higher). Alternative dosing to the HP/ LP turbine crossover is possible but requires detailed engineering.

### Testing

Daily water testing is extremely important for monitoring the actual performance of these treatments in a dynamic operating system. Any variations in water quality or chemical levels can signal the need for mechanical adjustments, treatment modification, or both. Boiler water samples should be taken from the continuous or surface blowdown, and feedwater samples as close as possible to the boiler. To ensure reliability, samples should be collected through a cooler. This process prevents distortion of test results from flashing, which concentrates the sample and drives off volatile materials.

The success of your boiler water treatment program depends as much on *reliable* test results as it does on *regular monitoring*. With fewer crew members available on most vessels to handle more tasks, accomplishing both goals can be a tall order. That is why Drew Marine has also pioneered advanced, simplified techniques for testing shipboard water treatments. Our most recent innovation in testing methodology utilizes *ampoule technology*, which provides numerous benefits over traditional techniques.

Our self-contained test kits have vacuum-sealed, self-filling ampoules containing pre-measured reagents. No mixing or special handling

of delicate, easily contaminated reagents is required. Supplied with easy-to-use equipment and procedures for adding samples and analyzing the readings, these kits are designed to ensure fast, accurate test results. There is no operator exposure to hazardous chemicals, or need for special reagent disposal, which provides added safety benefits for your crew. And the long shelf life of the reagents means less waste.



These benefits have all been built into the DREWPLEX boiler water treatment program. Ampoule kits are available for testing major system parameters, including:

**Oxygen Scavenger Levels** — Use the DREWPLEX OX Ampoule Test Kit *daily* to measure chemical levels in the feedwater. Dosing can then be adjusted to maintain the treatment concentration within the specified control range.

**Hardness** — The Total Hardness Ampoule test simplifies a *weekly* check on makeup quality.

**Ortho Phosphate** — The results obtained from *daily* tests enable you to control the level of sludge-producing phosphate relative to hardness levels in the feedwater.

An additional *daily* test procedure in the DREWPLEX program is necessary to ensure that sufficient free *hydroxide alkalinity* is present to keep calcium hardness sludges in a fluid, non-adherent form. Readings from this test are also used to help control hydroxide alkalinity in order to prevent low pH corrosion. Other procedures are provided for measuring *boiler water conductivity* and *condensate pH*.

The final proof of technological progress is the ability to make life easier—and this unique water treatment program delivers unsurpassed simplicity for your daily operation along with complete system protection. That is the ultimate benefit of specialized technical knowledge applied with decades of practical know-how. With appropriate training for operators, the full benefit from the DREWPLEX dual-treatment program can be achieved for your vessel with a daily testing and dosing routine that can be completed in less than twenty minutes.

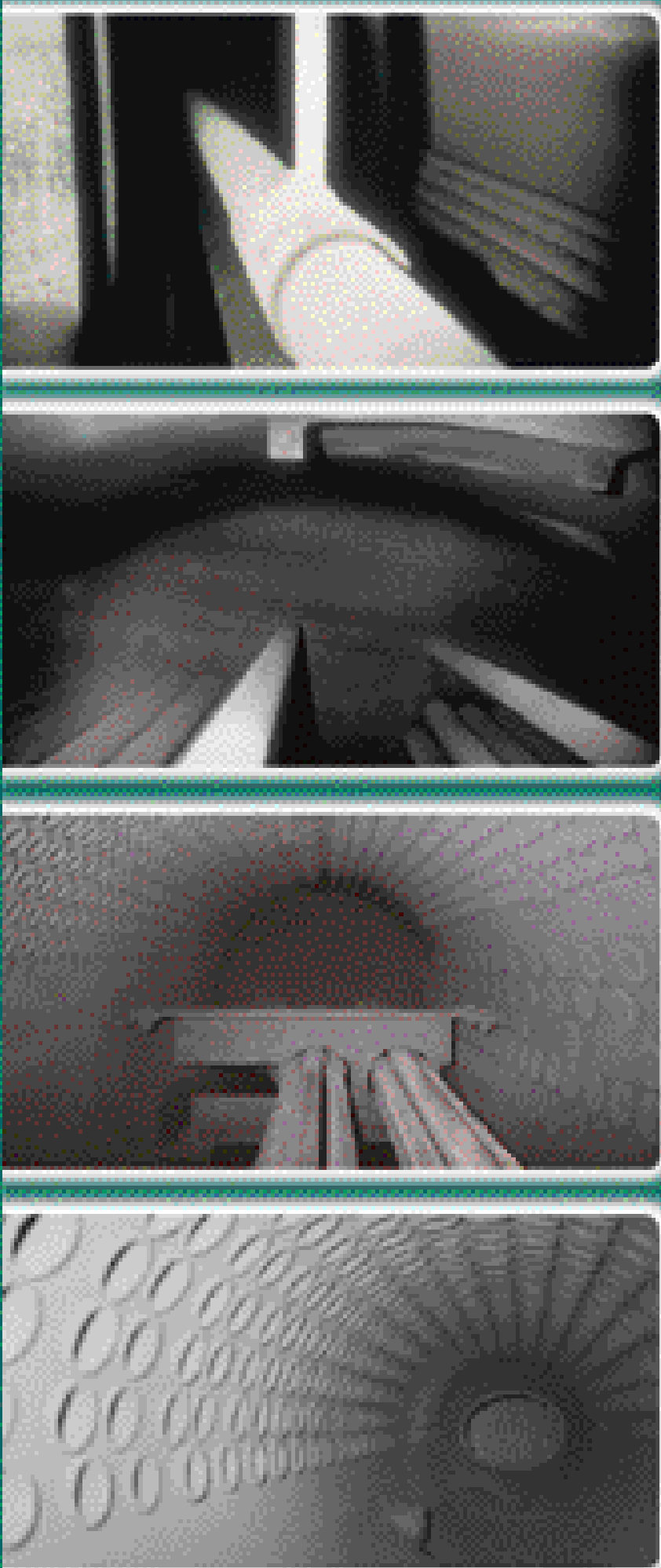
## Advanced Technology for Modern Realities

Drew Marine has responded to these challenges with technological advances that are certain to set new standards for the next era in marine low-pressure boiler water treatment. Our DREWPLEX® solution is a unique dual-treatment program with proven value for increasing the efficiency and life of the entire steam-generating system. It also provides the ultimate combination of simplicity, flexibility and control.

The "AT" in our new DREWPLEX AT boiler water treatment means "advanced technology" that builds and improves on our past successes. DREWPLEX AT is phosphate-based, with all the beneficial, non-hazardous components of its predecessor. The big PLUS is a blend of synthetic polymers, which contributes first to enhanced deposit control. In a major breakthrough for marine boilers, it also provides a reserve for feedwater upsets. This reserve assures a cleaner boiler even with typical variations in feedwater quality.

We have teamed this powerful treatment with a non-toxic, non-carcinogenic alternative to hydrazine. Designed for use with low-pressure boilers, DREWPLEX OX corrosion inhibitor is suitable for medium and high-pressure steam-generating systems as well. *And the best news is that the new treatment is better than hydrazine.* It functions in the same manner, reacting with oxygen and creating a passive oxide corrosion barrier on all metal surfaces throughout the steam-generating system. Yet it reacts more quickly at lower temperatures, and reaches the more distant sections of the boiler and connected piping systems. In addition to the advantage of independent corrosion control, DREWPLEX OX corrosion inhibitor's separate formulation allows for complete flexibility in dosing and control techniques, as well as locations.

The benefits of the combined DREWPLEX treatments add up to unprecedented peace of mind for ship operators and owners. Used properly, this revolutionary program eliminates boiler scale deposit buildup and metal loss—and minimizes system-wide steam, condensate and feedwater circuit corrosion from oxygen and low pH attack. That means you can count on trouble-free operation of your steam system and reliable availability of the services it supports. To help you achieve the fullest benefits, the DREWPLEX program also includes testing and dosing procedures designed for simple, safe, accurate use. And it is completely compatible with both manual and automated water treatment systems.



*The practical impact of properly applied DREWPLEX treatments is visible with every boiler inspection. Heat transfer surfaces are free of scale and sludge deposits, in spite of the inevitable variations in feedwater quality, and show no signs of corrosion from oxygen or low pH attack.*

## The Added Value of Drew Marine

Drew Marine specializes in technologies and services that can help our customers achieve their objectives and be successful in their businesses. You can count on us for the solutions and expertise you need. We are recognized and respected for maintaining the highest standards of quality. In addition, our experience in actively helping customers solve their problems has earned us a reputation for outstanding technical service that is unmatched in our industry. Over 3,500 customers operating more than 12,000 vessels attest to the superior performance provided by our integrated global organization, which features:

- Worldwide distribution and support network with 100 supply locations, serving over 900 ports in 48 countries.
- Efficient global communications network utilizing advanced technology for prompt response to all customer needs.
- Commitment to the principles of Responsible Care\*, an initiative of the U.S. Chemical Manufacturers Association for safeguarding both the environment, and health and safety in the workplaces and communities we serve.
- Technological leadership with superior customer needs-focused research and development
- Highly trained port service engineers and account specialists
- Dependable delivery
- Worldwide governmental and industry approvals

Ashland Specialty Chemical Company, a division of Ashland Inc., is a leading, worldwide supplier of specialty chemicals serving industries including adhesives, automotive, composites, foundry, merchant marine, paint, paper, plastics, semi-conductor, watercraft and water treatment. Ashland Inc. (NYSE:ASH) is a Fortune 500 company providing products, services, and customer solutions throughout the world. Our businesses include road construction, specialty chemicals, lubricants, car-care products, chemical and plastics distribution and transportation fuels. Find us at [www.ashland.com](http://www.ashland.com).

For confidence in boiler water quality guaranteed to promote peak efficiency in your steam-generating system, the DREWPLEX® dual-treatment program is the answer. Turn to Drew Marine for that extra measure of expertise and service that makes us the "Added Value" company.



For additional information contact:

### UNITED STATES

Ashland Specialty Chemical Company  
Drew Marine  
One Drew Plaza  
Boonton, NJ 07005 USA  
Telephone: (973) 263-7600  
FAX: (973) 263-7463/4491

### BRAZIL

Ashland Brasil Ltda.  
Av. Paris, 676  
Bonsucesso 21041-020  
Rio de Janeiro-RJ, Brazil  
Telephone: (55-21) 560-3330  
FAX: (55-21) 560-1538

### CHINA

Drew Ameroid (Singapore) Pte. Ltd.  
Shanghai Representative Office  
Room 209, Union Building  
100 Yan An East Road  
Shanghai 200002, China  
Telephone: (86-21) 6326-9708  
FAX: (86-21) 6373-3987

### INDIA

Ashland Specialty Chemical Company  
Drew Marine  
209, Nirman Kendra, No.3 Dr.E. Moses Rd.  
Mahalaxmi, Mumbai 400011, India  
Telephone: (91-22) 4910384  
FAX: (91-22) 4910386

### GERMANY

Drew Ameroid Deutschland GmbH  
Stenzelring 8  
D-21107 Hamburg, Germany  
Telephone: (49-40) 7524650  
FAX: (49-40) 75246512

### GREECE

Ashland Hellas Limited  
14, Skouze Street  
18536 Piraeus, Greece  
Telephone: (30-2) 104288056  
FAX: (30-2) 104183494

### HONG KONG

Drew Ameroid (Singapore) Pte. Ltd.  
Hong Kong Branch  
25th Floor, Aon Insurance Tower  
No.3, Lockhart Road  
Wanchai, Hong Kong  
Telephone: (852) 25202010  
FAX: (852) 28656472

### ITALY

Ashland Italia S.p.A.  
Drew Marine  
Via XXV Aprile 14/11  
16123 Genoa, Italy  
Telephone: (39-010) 2461532  
FAX: (39-010) 2461733

### JAPAN

Ashland Japan Co., Ltd.  
Minato-Ise Building 6F  
12-1, 3-Chome, Kaigan-Dori  
Naka-Ku, Yokohama 231, Japan  
Telephone: (81-45) 2124741  
FAX: (81-45) 2124754

### KOREA

Drew Ameroid (Singapore) Pte. Ltd.  
Korea Branch  
Room 702, Plaza Building  
80-5, 4-Ka, Jungang-Dong  
Jung-Ku, Busan, Korea  
Telephone: (82-51) 4622181  
FAX: (82-51) 4629854

### NETHERLANDS

Ashland Nederland B.V.  
Drew Marine  
Edisonweg 12  
3208 KB Spijkenisse, Netherlands  
Telephone: (31-181) 610774  
FAX: (31-181) 650906

### NORWAY

Ashland Norge A/S  
Fr. Nansens Plass 6  
0160 Oslo, Norway  
Telephone: (47) 23310370  
FAX: (47) 22425288

### SINGAPORE

Drew Ameroid (Singapore) Pte. Ltd.  
27 Tanjong Penjuru  
Jurong, Singapore 609025  
Telephone: (65) 62616544/9  
FAX: (65) 62650959

### TAIWAN

Drew Ameroid (Singapore) Pte. Ltd.  
Taiwan Branch  
Room 814, Hung Tai Sung Kiang Bldg.  
No. 152 Sung Kiang Road  
Taipei, Taiwan  
Telephone: (886-2) 2565-3010  
FAX: (886-2) 2565-3013

### UNITED KINGDOM

Ashland UK Limited  
Drew Marine  
110 Jermyn Street  
London SW1Y 6EE, U.K.  
Telephone: (44-207) 930-1130  
FAX: (44-207) 839-0348

**ASHLAND**  
ASHLAND SPECIALTY CHEMICAL COMPANY



### Drew Marine

Ashland Specialty Chemical Company  
Division of Ashland Inc.  
One Drew Plaza, Boonton, NJ 07005 U.S.A.  
Phone: (973) 263-7600  
FAX: (973) 263-4491/7463  
E-mail: [drewmarine@ashland.com](mailto:drewmarine@ashland.com)  
Web Site: [www.drew-marine.com](http://www.drew-marine.com)



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