

SBC-inter ApS's undated report

GOLAR MANAGEMENT (UK) Ltd

Report concerning: **Chemical cleaning of boilers onboard vessel Hilli**

Preliminary information

Place: Vessel Hilli - Freeport Bahamas Shipyard
Boiler type: Foster Wheeler ECD III
Boiler Volume: ~15 m³
Purpose: Removal of rust and iron scale.
Note! Super heater blocked. (Not to be cleaned)

Chemical cleaning handled by Derik Walton / Harris Pye Marine Ltd.
Monitoring and supervising by / SBC-inter ApS.

Circulation

Circulation of the boiler starting from the mixing tank, gravity feeding the circulation pump and is lead trough hoses to the lower drum of the boiler.
Output on steam drum, trough 1 hose and return to mixing tank.

Chemicals

Chemicals used for the cleaning was Descalex, an inhibited sulphamic acid from the manufacturer Unitor.

Boiler Cleaning

- 01.00 pm** Heating of the water stopped, reaching 57°C in mixing tank and workers starting to add chemicals into the mixing tank using personal protection.
- 02.25 pm** 800 kg Descalex has been added and dissolved in the mixing tank, the fluid has changed to the colour red. A rusty test flange is putted into the mixing tank to monitor the effect of the cleaning.

This amount of chemicals will result in a solution of ~5,3% acid. There is no test equipment available for confirming this!

Derik Walton starts steaming in the mixing tank, to maintain the temperature at 57°C, recommend stopping the heating because of damage to the inhibitors. (Steel- protection). Derik follows the recommendation and stops the steaming.

- 05.00 pm -** The fluid colour is changing from red to dark grey. Temperature of the fluid has dropped to 45°C.
Test shows that >5ppm iron is dissolved pr. Litre in the circulation fluid.
..... performs a steel wool test* of the process fluid to check if the inhibitor works – (test OK)

*A small steel wool ball is putted into a jar containing the process fluid. The inhibitor will protect the acid from dissolving the steel and the steel wool ball will drop to the bottom of the jar.
If the steel wool ball comes to the surface of the process fluid, the inhibitor has lost its effect and the acid will start dissolving the steel.

Continuous steel wool test* preformed from 5.00 pm to check if the inhibitor works –
(all test OK)

09.00 pm Steel wool ball comes to the surface of the process fluid .The inhibitor have lost the effect. The test flange is at this time looking metallic grey and cleaned from rust and iron scale.

..... recommend stopping the circulation and draining the boiler .The lost inhibitor effect may damage the inside of the boiler. Derik Walton-agrees and calls on the radio for getting the circulation stopped and then start to drain the boiler to the ballast tank.

Conclusion

From SBC-inter's point of view, the circulation system was insufficient for the task. The total volume is to be changed minimum 2 times an hour. Self suction pump should have been used.

The chemical "Descalex" used where a compound of sulphamic acid and inhibitors. By using steam as heater, the inhibitors will be damaged by the temperature. SBC-inter have never seen inhibitors resistant for more than 85°C.

Using a compound, SBC-inter recommend, having the right measuring/analyzing equipment, to establish the content/acid concentration. (Aware that coloration is a perimeter).

Economizer should always be cleaned, when settlements are observed in the pressure part of the boiler.

Best Regards

.....
SBC-inter ApS

Cleaning instructions in use at the time of the accident including overseer's annotations

BOILING OUT PROCEDURE

FOR NEW BOILERS/ RETUBED BOILERS

A - CLEANING METHOD

BY EXTERNAL HEATING AND BY CIRCULATION OF AN ALKALINE SOLUTION CONTAINING WATER SOFTENERS, WETTING AND RUST REMOVING AGENTS , WHICH QUICKLY PENETRATE THE SLUDGE , THE DIRT, THE LIGHT OXIDED SURFACES AND THE OILY/GREASY MATERIALS PRESENT ON THE SURFACES.

AN ALKALINE CLEANER SOLUTION AT 2,5 %* STRENGTH WILL BE USED LAC/ EDGE/ALKALINE BASED CLEANER ETC CAN BE USED ALTERNATIVELY, IN THE SAME PROPORTION AND/OR MIXED ACCORDING TO THE AVAILABILITY ...

* solution concentration may vary according to product used.

B - MATERIALS REQUIRED

- A CHEMICAL RESISTANT CIRCULATING PUMP (ALLOYS, COPPER ETC ARE VERY SENSITIVE TO ALKALINE SOLUTIONS)
- A TANK (OF SUFFICIENT CAPACITY FOR MIXING THE CHEMICALS/AND AS BUFFERTANK)
- STEEL PIPING - FITTINGS - VALVES
- VENT PIPES TO CARRY GASES FROM THE BOILER TO THE OUTSIDE.
- HEATING COIL IN MIXING TANK OR EXTERNAL AUXILIARY BOILERS TO MAINTAIN PERMANENTLY BOILING OUT SOLUTION AT 60-70°C (MAX : 70°C).
- PROTECTIVE CLOTHING FOR PERSONNAL INVOLVED IN THE PERFORMANCE.
- SUFFICIENT QUANTITY OF CHEMICALS TO PERFORM THE BOILING OUT AND AMERZINE FOR THE PASSIVATION
- FRESH WATER CONNECTION TO REFILL ENTIRELY BOILER AND TO MAINTAIN WATER LEVEL PERMANENTLY INTO THE MIXING TANK.

C - CLEANING PROCEDURE

NOTE ABOUT SAFETY

READ TECHNICAL AND SAFETY DATA SHEETS AND MAKE SURE THAT ALL OPERATING PERSONNELS UNDERSTAND AND FOLLOW SAFETY PROCEDURES CAREFULLY, HAVE THE PROPER EQUIPMENT ON HAND AND EMMERGENCY CORRECTING AND REMEDIAL ACTIONS ARE PLANNED TO RESPOND TO PROBLEMS IF IT BECOMES NECESSARY.

- TEST THE SYSTEM PRIOR INTRODUCING THE CHEMICALS AND ENSURE THERE IS NO LEAKAGES ARE NOTICED.
- PREVENT OVERFLOWING(DANGER AND LOSS OF CHEMICALS)
- ENSURE THE GASES ARE WELL VENTED TO THE ATMOSPHERE
- COMPLY WITH ALL REGULATION IN FORCE.

SPECIAL ATTENTION IS TO BE PAID TO THE SUPER HEATER WHICH CAN ONLY BE FILLED WITH DISTILLED WATER AND VOLATILE CHEMICAL (AMERZINE OXYGEN SCAVANGER AND SLCC-A) OR BE BLANKETTED WITH NITROGEN.

A- IF THE BOILER IS NOT TO BE RETURNED INTO SERVICE

- MAINTAIN AMERZINE AS IT IS AFTER PASSIVATION
- IF NOT ALREADY DONE IN THE PREVIOUS STEP DOSE GC ALKALINE TO BRING THE PH OR ALKALINITY LEVEL SAME AS ON WORKING CONDITION (SEE PRESSURE RANGE RESPECTIVE CONTROL CHARTS)
- ENSURE THE BOILER IS COMPLETELY FILLED TO EXCLUDE ALL AIR SUPERHEATER WELL ISOLATED.
A TEMPORARY HEADER TANK CAN BE FITTED ON THE UPPEST STEAM DRUM POSSIBLE CONNECTION TO ENSURE THE WATER VOLUME FLUCTUATION ARE COMPENSATED AND PREVENT AIR TO ENTER THE SYSTEM.
- ENSURE THERE IS NO LEAKAGES, THEN PUT THE SYSTEM INTO LAY UP

B- IF THE SYSTEM IS TO BE RETURNED INTO SERVICE

IT IS PREFERABLE THE BOILER IS NOT PUT INTO NORMAL SERVICE DURING OR IMMEDIATELY FOLLOWING THIS PROCESS AS EXCESSIVES AMOUNT OF HYDRAZINE CAN PASS OVER TO THE STEAM/CONDENSATE/FEED SYSTEM AND APART GIVING HIGH CONDUCTIVITY CAN ALSO EXCESSIVELY RISE THE CONDENSATE PH

IF THE SYSTEM HAD BEEN LEFT IN LAY UP FOR A CERTAIN TIME; IT IS ALWAYS PREFERABLE, ESPECIALLY FOR HIGH PRESSURE BOILER VESSEL, AND WHEN THE SYSTEM HAD BEEN COMPLETELY CLEANED PRIOR LAY UP, TO COMPLETELY DRAIN THE SYSTEM AS IT WILL ENSURE THE ELIMINATION OF ALL SOLIDS AND EXHAUSTED CHEMICALS. THEN REFILL IT WITH THE HIGHEST QUALITY DISTILLED WATER AND INTRODUCE THE CHEMICAL AT INITIAL DOSAGE.

IF CASE IT IS NOT POSSIBLE THEN PROCEED TO THE NEXT STEPS.

- BRING TO WORKING LEVEL CONDITION, ENSURE THE SUPER HEATER IS DRIED.
- DOSE THE OTHER CHEMICALS (INITIAL DOSAGE)
- HEAT SLOWLY
- DRUM VENT AND SUPER HEATER VENT SHOULD BE OPEN TO DISSIPATE HIGH LEVEL OF VOLATILE CHEMICALS.
- PERFORM THE WATER TESTS AND MAKE NECESSARY ADJUSTMENT DOSAGE / BLOWDOWN
- MAINTAIN THE CONDUCTIVITY AT A LOW PROFILE, CHECK PH, AMERZINE, AMMONIA LEVEL. AND MAINTAIN ALL THE OTHER LIMITS

ALL THE HERE ABOVE RECOMMENDATION ARE GLOBAL AND INDICATIVE FINAL PROCEDURES, SAFETY, ENVIRONMENTAL ETC... WILL BE FIXED BY THE MASTER AND / OR THE CHIEF ENGINEER, TO COMPLY WITH MANUFACTURER INSTRUCTIONS, WITH SAFETY AND REGULATION IN FORCE.

- MASTER , CHIEF ENGINEER TO ENSURE PROPER PROCEDURE AND ENSURE THEY ARE FULLY OBSERVED AND THE REGULATION FULLY APPLIED
- OPEN ALL ACCESS PORTS, MANHOLE COVERS AND AS MANY HAND-HOLE CAPS AS PRACTICAL.
- REMOVE AS MUCH DEBRIS AND DEPOSIT ACCUMULATION AS POSSIBLE BY FLUSHING WITH HIGH VELOCITY WATER FLOW
- REMOVE ALL SACRIFICIAL ANODES/SOFT PLUGS ETC, BLANK OFF/ REMOVE ALL INSTRUMENT LEADS.
- ENSURE THE SUPERHEATER IS WELL ISOLATED.
- INSTALL THE VENT PIPING FROM A TOP OPENING IN THE BOILER TO THE OUTSIDE. THIS IS VERY IMPORTANT TO ELIMINATE GASES ACCUMULATIONS. MAKE SURE THE VENT IS OPERABLE AND FULLY OPENED.
- MAKE NECESSARY CONNECTIONS FOR CLEANING SOLUTION CIRCUIT.
 - RUN A LINE FROM ONE END OF THE "TEE" TO WASTE.
- INSTALL A SHUT-OFF VALVE IN THIS LINE.
- RUN A LINE FROM THE TOP OF THE MIXING TANK TO THE SUCTION SIDE OF THE CIRCULATING PUMP.
- RUN ANOTHER LINE FROM THE DISCHARGE OF THE CIRCULATING PUMP TO THE TOP OF THE BOILER.
- INSTALL A CHECK VALVE AND A SHUT-OFF VALVE IN THIS LINE.
- SET ALL VALVES PROPERLY, CLOSE ALL ACCESS PARTS, MANHOLES, HANDHOLES.
- IF THE CIRCULATING PUMP IS SUFFICIENT, IT IS PREFERABLE TO MAKE CONNECTION ON THE OPPOSITE, I.E. SUCTION LINE CONNECTED ON THE BOTTOM OF THE MIXING TANK AND DISCHARGE LINE AT THE BOILER BOTTOM BLOWDOWN VALVES. THE RETURN BEING MADE FROM THE TOP OF THE BOILER OVERFLOWING DIRECTLY INTO THE MIXING TANK. THIS WILL PREVENT PLUGGING OF THE LINES IN CASE OF HEAVY DEPOSIT ACCUMULATION AT THE BOTTOM.
- FILL BOILER TO APPROXIMATIVELY 70% OF ITS VOLUME WITH FRESH WATER.
- ADD SUFFICIENT CHEMICAL TO OBTAIN THE RECOMMENDED STRENGTH SOLUTION TO THE SYSTEM. WHICH ONE CAN BE INCORPORATED DIRECTLY FROM THE TOP INTO THE BOILER INSIDE THE STEAM DRUM OR PREPARED INTO THE MIXING TANK, DISCHARGED AS CONCENTRATED SOLUTION INTO THE BOILER VIA THE CIRCULATING PUMP WHICH WILL ENSURE GOOD MIXING.
- WHEN ALL CONCENTRATED CHEMICAL SOLUTION IS INCORPORATED INTO THE BOILER, CONTINUE FILLING THE SYSTEM UNTIL THE SOLUTION RETURNS TO THE CHEMICAL MIXING TANK, THEN START TO IRCULATE AND REGULATE THE FLOW OF SOLUTION SO THAT, THE PUMP REMOVES THE WATER FROM THE TANK AT THE SAME RATE IT IS ADDED. OVERFLOW MUST BE ABSOLUTELY AVOIDED LIKE ANY LEAKAGE IN THE CIRCUIT. AS IT IS DANGEROUS , AND ALSOS WILL REDUCE THE CHEMICAL CONCENTRATION WHICH COULD RESULTS IN CLEANING FAILURE

- MAKE CERTAIN THAT THE VENT IS FULLY OPENED AND WORKS PROPERLY.
- START HEATING OF THE SOLUTION TO THE RANGE OF 60°/70°C. THE EXACT TIME OF THE BOILING OUT STARTS WHEN ALL THE SOLUTION INSIDE THE BOILER HAS REACHED THE RECOMMENDED TEMPERATURE OF 60°/70°C HOLD THIS TEMPERATURE RANGE THROUGHOUT ALL THE CLEANING PROGRAM WHICH MUST BE 10/12 HOURS

Do NOT HEAT WHILE ACID

- | |
|--|
| <ul style="list-style-type: none"> • DO NOT HEAT SOLUTION OVER 70°C. • DO NOT ALLOW THE SOLUTION TO REMAIN IN THE EQUIPMENT FOR MORE THAN A TOTAL OF 24 HOURS. |
|--|

INSIDE
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- DURING THE CLEANING, CHECK THE SOLUTION STRENGTH BY GETTING SAMPLES AT CONVENIENT LOCATIONS. STRENGTH CAN BE RE ESTABLISHED BY ADDITION OF CHEMICAL
- IF TOO MUCH DEPOSITS ARE DISSOLVED OR LOOSENED AND START TO PLUG THE LINES, PARTICULARLY AT THE BOTTOM, BLOWDOWN THE EQUIPMENT. SINCE THIS PROCESS RESULTS IN WATER-LOSS, RE-ESTABLISH THE ORIGINAL LEVELS WITH FRESH WATER AND ALSO CORRESPONDING QUANTITIES OF CHEMICAL, TO MAINTAIN THE SOLUTION STRENGTH.

D - WHEN CLEANING IS COMPLETE, COOL AND DRAIN THE EQUIPMENT

- DRAIN THIS WASTE SOLUTION IN ACCORDANCE WITH SAFETY REGULATIONS IN A TANK OR A BILGE WHERE NEUTRALIZATION CAN BE ACCOMPLISHED BEFORE OVERLOADING OR SHORESIDE DISCHARGE.
- AS SOON AS THE SOLUTION LEVEL HAD DROPPED BELOW THE TOP ACCESS MANHOLE OF STEAM DRUM, OPEN THEM AND THOROUGHLY FLUSH WITH A HIGH PRESSURE FRESH WATER FLOW. CONTINUE FLUSHING WHILE DRAINING TO REMOVE ALL LOOSENED DEPOSITS TO MAKE CERTAIN THAT ALL THE TUBES ARE CLEAN AND FREE OF DEPOSIT ACCUMULATION.
- FLUSH UNTIL PH LEVEL RETURNED NEUTRAL
- THEN INSPECT LOWER WATER DRUM AND PROCEED TO MANUAL CLEANING IF THERE IS TOO MUCH ACCUMULATION OF LOOSENED DEPOSITS.

E - PASSIVATION

I- THE PURPOSE OF THE PASSIVATION : IS TO FORM A PROTECTIVE MAGNETIC LAYER ON THE METAL SURFACES TO PREVENT OXYGEN CORROSION
AMERZINE WILL BE USED AND IT WILL TRANSFORM THE Fe_2O_3 OXYDE SURFACES INTO THE Fe_3O_4 FORM WHICH IS CORROSION RESISTANT. (DREWPLEX OX CAN ALSO BE USED FOR THAT PURPOSE)

THIS PASSIVATION IS NECESSARY ON NEW BOILER AFTER BOILING OUT IS ACCOMPLISHED, OR AFTER AN ACID WASH HAD BEEN PROVIDED TO THE SYSTEM. AS THE SURFACES ARE EXPOSED TO FLASH RUSTING PROCESS

II- PASSIVATION PROCESS

- ONCE THE BOILING OUT IS COMPLETED REFILL COMPLETELY THE SYSTEM BY ADDING 1.3 - 1.5 LITER / TON OF AMERZINE CORROSION INHIBITOR. AND MAINTAIN THE PH OR THE ALKALINITY AT THE NORMAL WORKING RECOMMENDED LEVEL (REFER TO THE APPROPRIATE PRESSURE CONTROL CHARTS INDICATIONS)
- CIRCULATE THE SOLUTION FOR 24HOURS AT LEAST. OR MORE IF TIME IS AVAILABLE.

BOILER DESCALING PROCEDURE

(WITH SAF-ACID AND SALT)

MAKE SURE THAT ALL OPERATING PERSONNEL UNDERSTANDS AND FOLLOWS SAFETY PRO-CEDURES CAREFULLY MENTIONED IN THE MATERIAL SAFETY DATA SHEETS.

MODULE 2.1.5	REMOVAL OF SCALE AND CORROSION PRODUCTS FROM OIL FIRED BOILERS
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CHEMICALS:	SAF-ACID (DESCALANT) and	SOLUTION STRENGTH: 10
	NACL (COMMON SALT)	%
	GC (NEUTRALIZATION)	SOLUTION STRENGTH: 5
		%
		SOLUTION STRENGTH: 1
		%

PLEASE NOTE: THE UNIT TO BE CLEANED <u>MUST NOT</u> CONTAIN STAINLESS STEEL INTERNALS!

1-CLEANING PROCEDURE:

PLEASE NOTE, THAT DEPOSITS SUCH AS OIL AND ORGANIC MATERIALS SHOULD BE REMOVED PRIOR TO ACID CLEANING! REFER TO MODULE 2.1.1 OR 2.1.2!

- **SECURE EQUIPMENT TO BE CLEANED FROM SERVICE, SEGREGATE OR BLANK OFF FROM SYSTEM AS A WHOLE AND COOL BEFORE DRAINING.**
- **OPEN ALL ACCESS PORTS, MANHOLE COVERS AND AS MANY HANDHOLE CAPS AS PRACTICAL.**
- **REMOVE AS MUCH DEBRIS AND DEPOSIT ACCUMULATION AS POSSIBLE BY FLUSHING WITH HIGH VELOCITY WATER FLOW OR MANUAL.**
- **FILL EQUIPMENT TO APPROX. 75 % OF ITS VOLUME WITH FRESH WATER (TO COVER THE TOP ROW) AND ADD SAF-ACID AS WELL AS NACL SOLUTION TO ESTABLISH RECOMMENDED STRENGTH. SECURE REMAINING OPENING IN EQUIPMENT MAKING CERTAIN THAT VENT IS FULLY OPEN.**
- **INTERNAL HEATING AND NATURAL CIRCULATION OF THE CLEANING SOLUTION IS OBTAINED BY LIGHTLY FIRING THE BOILER FOR SHORT PERIODS (5 MINUTES EVERY 15 TO 30 MINUTES). DO NOT EXCEED 7 BAR. ~~TEMPERATURE RANGE TO BE KEPT 60--70 °C.~~ DO NOT EXCEED ACID SOLUTIONS OVER 70 °C. SHORT BLOW DOWNS WILL REMOVE LOOSENEED SOILS.**
- **SAF-ACID HAS A BUILT-IN INDICATOR WHICH SHOWS BY ITS COLOR WHEN ITS STRENGTH HAS WEAKENED TO THE POINT WHERE**

ADDITIONAL ACID MAKE-UP IS REQUIRED. AT ITS STRONGEST POINT, ITS COLOR IS "GOLDEN". AS IT WEAKENS, THE COLOR WILL CHANGE TO "GREEN".

- CONTINUE CLEANING UNTIL THE STRENGTH OF THE SOLUTION STABILIZES, I.G., REMAINS "GOLDEN" IN COLOR.
- DURING THE CLEANING PROCESS AS THE SCALE, SLUDGE, AND OTHER DEPOSITS ARE LOOSENED THE STRENGTH OF THE ACID DECREASES. TO ASSURE SUCCESS, THE STRENGTH OF THE CLEANING SOLUTION MUST BE RE-ESTABLISHED. IN THIS CASE MORE SAF-ACID (APPROX. 25 % OF THE INITIAL DOSE) SHOULD BE ADDED. THE REFRESHMENT DOSE OF NACL IS 50 % OF THE SECOND SAF-ACID DOSE. HOWEVER, IF THE EQUIPMENT HAS EXCESSIVELY LARGE AMOUNTS OF DEPOSITS, IT IS OFTEN A GOOD PRACTICE TO DRAIN THE INITIAL CLEANING SOLUTION AFTER 2 - 6 HOURS. THEN THE CLEANING PROCESS MUST BE STARTED FROM THE BEGINNING.
- OVERALL CLEANING TIME WILL BE IN THE ORDER OF 6 - 12 HOURS, BUT DO NOT EXCEED 24 HOURS CONTACT TIME WITH ACID SOLUTIONS.
- WHEN THE CLEANING IS COMPLETE, COOL AND DRAIN THE EQUIPMENT. AS SOON AS THE SOLUTION LEVEL HAS DROPPED BELOW THE TOP ACCESS PORTS, OPEN THEM AND THOROUGHLY FLUSH WITH FRESH WATER. CONTINUE FLUSHING WHILE DRAINING.
- DRAIN THE ACID WASTE SOLUTION TO A TANK OR BILGE WHERE NEUTRALIZATION CAN BE ACCOMPLISHED BEFORE OVERBOARD OR SHORESIDE DISCHARGE.
- REMOVE ALL LOOSENED DEPOSITS BY FLUSHING OR MANUAL CLEANING.
- REFILL THE UNIT WITH FRESH WATER TO THE TOP ROW.
- FOR NEUTRALIZATION ADD THE PRECALCULATED AMOUNT OF GC TO THE EQUIPMENT. HEAT TO 60 - 70 °C AND OBTAIN NATURAL CIRCULATION AS MENTIONED ABOVE FOR 1 - 2 HOURS OR UNTIL THE PH OF THE SOLUTION IS NEUTRAL OR HIGHER.
- COOL DOWN AND DRAIN THE SOLUTION TO THE SAME TANK OR BILGE HOLDING THE WASTE ACID FROM THE CLEANING AND FLUSH THE UNIT WITH FRESH WATER.
- SECURE OPENING, REFILL SYSTEM WITH WATER, AND CIRCULATE FOR 30 MINUTES TO 1 HOUR. DRAIN AND FLUSH SYSTEM AGAIN.
- INITIAL DOSE BOILER WATER TREATMENT CHEMICAL.
- EQUIPMENT IS NOW READY FOR RETURN IN SERVICE.

PRECALCULATION EXAMPLE

OF SAF-ACID AND NACL REQUIRED FOR DESCALING AS WELL AS GC REQUIRED FOR NEUTRALIZATION OF OIL FIRED BOILER BASED ON A WATER CAPACITY OF 17.3 TONS.

Volume $15 \text{ m}^3 = 525 \text{ kg}$ Til 3.5 %

$\rightarrow \times 10 \rightarrow 5250 \text{ kg}$

SAF-ACID CLEANING SOLUTION STRENGTH: 10 %
NACL QUANTITY: 50 % OF SAF-ACID DOSE

1730 KG
865 KG } = 1.48

SAF-ACID FOR REFRESHING THE INITIAL CLEANING SOLUTION:
NACL QUANTITY FOR REFRESHING: 50 % OF SAF-ACID DOSE

433 KG
216.5 kg
216 KG

GC NEUTRALIZATION SOLUTION STRENGTH: 1 %

173 LTR.

MAKE SURE THAT ALL OPERATING PERSONNEL UNDERSTANDS AND FOLLOWS SAFETY PRO-CEDURES CAREFULLY MENTIONED IN THE MATERIAL SAFETY DATA SHEETS.

? WHAT ACID SOLUTION IS WISHED
PASSIVATION

I- THE PURPOSE OF THE PASSIVATION : IS TO FORM A PROTECTIVE MAGNETIC LAYER ON THE METAL SURFACES TO PREVENT OXYGEN CORROSION.

AMERZINE OR DREWPLEX OX WILL BE USED AND IT WILL TRANSFORM THE Fe_2O_3 OXYDE SURFACES INTO THE Fe_3O_4 FROM WHICH IS CORROSION RESISTANT.

THIS PASSIVATION IS NECESSARY ON NEW BOILER AFTER BOILING OUT IS ACCOMPLISHED, OR AFTER AN ACID WASH HAD BEEN PROVIDED TO THE SYSTEM.

II- PASSIVATION PROCESS

- ONCE THE ACID CLEANING, AND NEUTRALISATION ARE COMPLETED REFILL COMPLETELY THE SYSTEM BY ADDING 1.3 - 1.5 LITER / TON OF AMERZINE CORROSION INHIBITOR AND PREFERABLY MAINTAIN THE PH OR THE ALKALINITY AT THE NORMAL WORKING VALUE (REFER TO THE APPROPRIATE PRESSURE CONTROL CHARTS INDICATIONS)

NOTE SPECIAL ATTENTION MUST BE PAID TO THE SUPER HEATER WHICH CAN ONLY BE FILLED WITH GOOD QUALITY DISTILLED WATER AND "VOLATILE" CHEMICALS (AMERZINE/DREWPLEX OX OXYGEN SCAVANGER AND SLCC-A) OR BE BLANKETTED WITH NITROGEN.

A- IF THE BOILER IS NOT TO BE RETURNED INTO SERVICE

- MAINTAIN AMERZINE OR DREWPLEX OX
- IF NOT ALREADY DONE IN THE PREVIOUS STEP DOSE GC ALKALINE TO BRING THE PH OR ALKALINITY LEVEL SAME AS ON WORKING CONDITION (SEE PRESSURE RANGE RESPECTIVE CONTROL CHARTS)
- ENSURE THE BOILER IS COMPLETELY FILLED TO EXCLUDE ALL AIR SUPERHEATER WELL ISOLATED.

A TEMPORARY HEADER TANK CAN BE FITTED ON THE UPPER STEAM DRUM POSSIBLE CONNECTION TO ENSURE THE WATER VOLUME FLUCTUATION ARE COMPENSATED AND PREVENT AIR TO ENTER THE SYSTEM.

- ENSURE THERE IS NO LEAKAGES
- THEN PUT THE SYSTEM INTO LAY UP

B- IF THE SYSTEM IS TO BE RETURNED INTO SERVICE

IT ALWAYS BE PREFERABLE , ESPECIALLY FOR HIGH PRESSURE BOILER VESSEL AND WHEN THE SYTEM HAD BEEN COMPLETELY CLEANED PRIOR LAY UP TO COMPLETELY DRAIN THE SYSTEM TO ENSURE ELIMINATION OF ALL SOLIDS AND EXHAUSTED CHEMICALS . THEN REFILLED IT WITH THE HIGHEST QUALITY DISTILLED WATER AND INTRODUCE THE CHEMICAL AT INITIAL DOSAGE .

IF CASE IT IS NOT POSSIBLE THEN PROCEED TO THE NEXT STEPS .

- BRING TO WORKING LEVEL CONDITION, ENSURE THE SUPER HEATER IS DRIED.
- DOSE THE OTHER CHEMICALS (INITIAL DOSAGE)
- HEAT SLOWLY
- DRUM VENT AND SUPER HEATER VENT SHOULD BE OPEN TO DISSIPATE HIGH LEVEL OF VOLATILE CHEMICALS.
- CONDUCT THE WATER TEST AND MAKE NECESSARY ADJUSTMENT DOSAGE / BLOWDOWN
- MAINTAIN THE CONDUCTIVITY AT A LOW PROFILE, CHECK PH, AMERZINE, AMMONIA LEVEL. AND MAINTAIN ALL THE OTHER LIMITS

ALL THE HERE ABOVE RECOMMENDATION ARE GLOBAL AND INDICATIVE FINAL PROCEDURES, SAFETY, ENVIRONMENTAL ETC... WILL BE FIXED BY THE MASTER AND / OR THE CHIEF ENGINEER, TO COMPLY WITH MANUFACTURER INSTRUCTIONS, WITH SAFETY AND REGULATION IN FORCE.

Important Information

Ashland Specialty Chemical Company's Drew Marine Division maintains Material Safety Data Sheets on all of its products. Material Safety Data Sheets contain health and safety information for your development of appropriate product handling procedures to protect your employees and customers. OUR MATERIAL SAFETY DATA SHEETS SHOULD BE READ AND UNDERSTOOD BY ALL YOUR SUPERVISORY PERSONNEL AND EMPLOYEES BEFORE USING DREW'S PRODUCTS IN YOUR FACILITIES.

All statements, information and data presented herein are believed to be accurate and reliable but are not to be taken as a guarantee, express warranty or implied warranty of merchantability or fitness for a particular purpose, or representation, express or implied, for which either assumes legal responsibility, and they are offered solely for your consideration, investigation and verification. Statements or suggestions concerning possible use of this product are made without representation or warranty that any such use is free of patent infringement and are not recommendations to infringe on any patent.

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International Labour Organization's - International Chemical Data Sheet No 0328 for Sulphamic Acid

SULFAMIC ACID

0328

October 1994

CAS No: 5329-14-6
RTECS No: WO5950000
UN No: 2967
EC No: 016-026-00-0

Amidosulfonic acid
Amidosulfuric acid
Sulfamidic acid
 $\text{H}_3\text{NO}_3\text{S} / \text{NH}_2\text{SO}_3\text{H}$
Molecular mass: 97.1

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/SYMPTOMS	PREVENTION	FIRST AID/FIRE FIGHTING
FIRE	Combustible under specific conditions. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames.	Water spray, foam, powder, carbon dioxide.
EXPLOSION			In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		PREVENT DISPERSION OF DUST! STRICT HYGIENE!	
Inhalation	Burning sensation. Cough. Shortness of breath.	Local exhaust or breathing protection.	Fresh air, rest. Half-upright position. Artificial respiration may be needed. Refer for medical attention.
Skin	Redness. Pain. Blisters.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse skin with plenty of water or shower. Refer for medical attention.
Eyes	Redness. Pain. Severe deep burns.	Face shield or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion	Abdominal cramps. Burning sensation. Sore throat. Vomiting. Shock.	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Refer for medical attention.
SPILLAGE DISPOSAL		PACKAGING & LABELLING	
Sweep spilled substance into containers; if appropriate, moisten first to prevent dusting. Cautiously neutralize remainder. Then wash away with plenty of water. Personal protection: P2 filter respirator for harmful particles.		Xi Symbol R: 36/38-52/53 S: (2-)26-28-61 UN Hazard Class: 8 UN Pack Group: III Do not transport with food and feedstuffs.	
EMERGENCY RESPONSE		SAFE STORAGE	
Transport Emergency Card: TEC (R)-80GC2-II+III		Separated from strong bases, food and feedstuffs. Dry.	

IPCS

International
Programme on
Chemical Safety



Prepared in the context of cooperation between the International Programme on Chemical Safety and the European Commission ©
IPCS 2005

SEE IMPORTANT INFORMATION ON THE BACK.

IMPORTANT DATA

Physical State; Appearance

ODOURLESS, COLOURLESS CRYSTALS OR POWDER.

Chemical dangers

The substance decomposes on heating or on burning producing toxic and corrosive fumes including nitrogen oxides and sulfur oxides. The solution in water is a strong acid, it reacts violently with bases and is corrosive. Reacts violently with chlorine and fuming nitric acid causing explosion hazard. Reacts slowly with water to form ammonium bisulfate.

Occupational exposure limits

TLV not established.

Routes of exposure

The substance can be absorbed into the body by inhalation of its aerosol and by ingestion.

Inhalation risk

Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly when dispersed, especially if powdered.

Effects of short-term exposure

The aerosol is corrosive to the eyes, the skin and the respiratory tract. Inhalation of sulfamic acid aerosols may cause lung oedema (see Notes).

PHYSICAL PROPERTIES

Melting point (decomposes): about 205°C
Relative density (water = 1): 2.15

Solubility in water: moderate (slow reaction)

ENVIRONMENTAL DATA

NOTES

The symptoms of lung oedema often do not become manifest until a few hours have passed and they are aggravated by physical effort. Rest and medical observation is therefore essential.

Immediate administration of an appropriate inhalation therapy by a doctor or a person authorized by him/her, should be considered. Card has been partly updated in October 2005. See sections EU classification, Emergency Response.

ADDITIONAL INFORMATION

LEGAL NOTICE

Neither the EC nor the IPCS nor any person acting on behalf of the EC or the IPCS is responsible for the use which might be made of this information

Mr Walton's boiler chemical cleaning documentation produced on 24 April 2003

SUGGESTED PROCEDURE FOR ACID WASHING OF

WATER TUBE BOILERS USING SALPHAMIC ACID

Please read this information completely before commencing the process

DESCRIPTION

Easy Descaler is a fast acting and effective liquid Sulphamic Acid.

The product contains an inhibitor to prevent attack of base metal after the cleaning program has been completed and a dye which visually indicates when the cleaning potential of the acid has been neutralised.

An additional feature is that any rust present in the will also be removed in the cleaning process.

N.B. Easy descaler does not contain hydrochloric acid and is therefore safe for stainless steel.

APPLICATION AND USE

Easy Descaler is used to dissolve water formed deposits from metal equipment.

CLEANING OF BOILERS

General information

No attempt should be made to acid clean a boiler where the deposits contain copper or a high percentage of silica.

Do not allow acid solution to remain in equipment for more than a total of 24 hours.

As with all acid cleaning , be sure to remove zinc plates and rods or other sacrificial anodes before cleaning.

The acid cleaning process can generate flammable / hazardous gas.
DO NOT PERFORM HOT WORK WHEN ACID IS IN CIRCULATION.

Always make sure that equipment has sufficient ventilation to prevent the accumulation.

- **The boiler must never be fired while containing an acid solution.**
- **Vent to the outside**

NOTE: Care should be taken to follow local disposal regulations with all waste water.

EQUIPMENT REQUIRED

Proper planning is essential for acid cleaning.

The following items are required:

1. A mixing tank
2. Circulating pump
3. Heating system
4. Vent pipe to carry gases released during the cleaning to the outside
5. Protective clothing. This includes goggles or splash shield, rubber gloves and a apron.

Pretesting for leaks

Before cleaning begins, equipment should be checked for leaks. Prepare the chemical cleaning equipment ,fill the equipment to be cleaned. Maintain the level of water in the mix tank at half full. Circulate the water by means of the pump and check to be certain there are no leaks in the piping and that the equipment is functioning . If there are no leaks in the system ,proceed with cleaning.

Cleaning procedure

Install the vent piping from the top opening in the boiler to the outside

Set all valves properly .Fill the boiler the bottom of the gauge with water as well as the mix tank ,pump and hoses .Heat the water to 65c [150f]

Start the circulating pump and regulate the flow of solution so that the pump removes water from the mix tank at the same rate as it is added.

Slowly add the proper amount of Easy Descaler Plus to the mixing tank . A solution of 10% will be required by weight solution relative to the size of the boiler

When the acid cleaning solution is exhausted it will turn from Red to Orange if this occurs, add approximately 25% of the initial dose. Cleaning is complete when the strength of the Descaler Holds steady for a least two [2] hours as indicated by a steady Red colour. After two [2] hours stop the pump, drain and flush boiler .

After the boiler is flushed , fill the boiler with water and add the required amount of concentrated alkaline liquid to obtain a 1% solution. This will neutralise any acid remaining in the equipment. Circulate the neutralising solution for a minimum of two hours.

Once neutralised, drain and inspect the boiler . If necessary wash with a high pressure hose.

If not returned to service , the boiler must be passivated. Temperature and Pressure is required for this process . However it is recommended to refill the boiler to half gauge glass heat to 60/70c add HYDRAZINE at 1.5ltrs per tonne of water circulate for six hours with the vent valve shut. Although it is not possible to passivate at these temperatures it will prevent any flash rusting occurring.

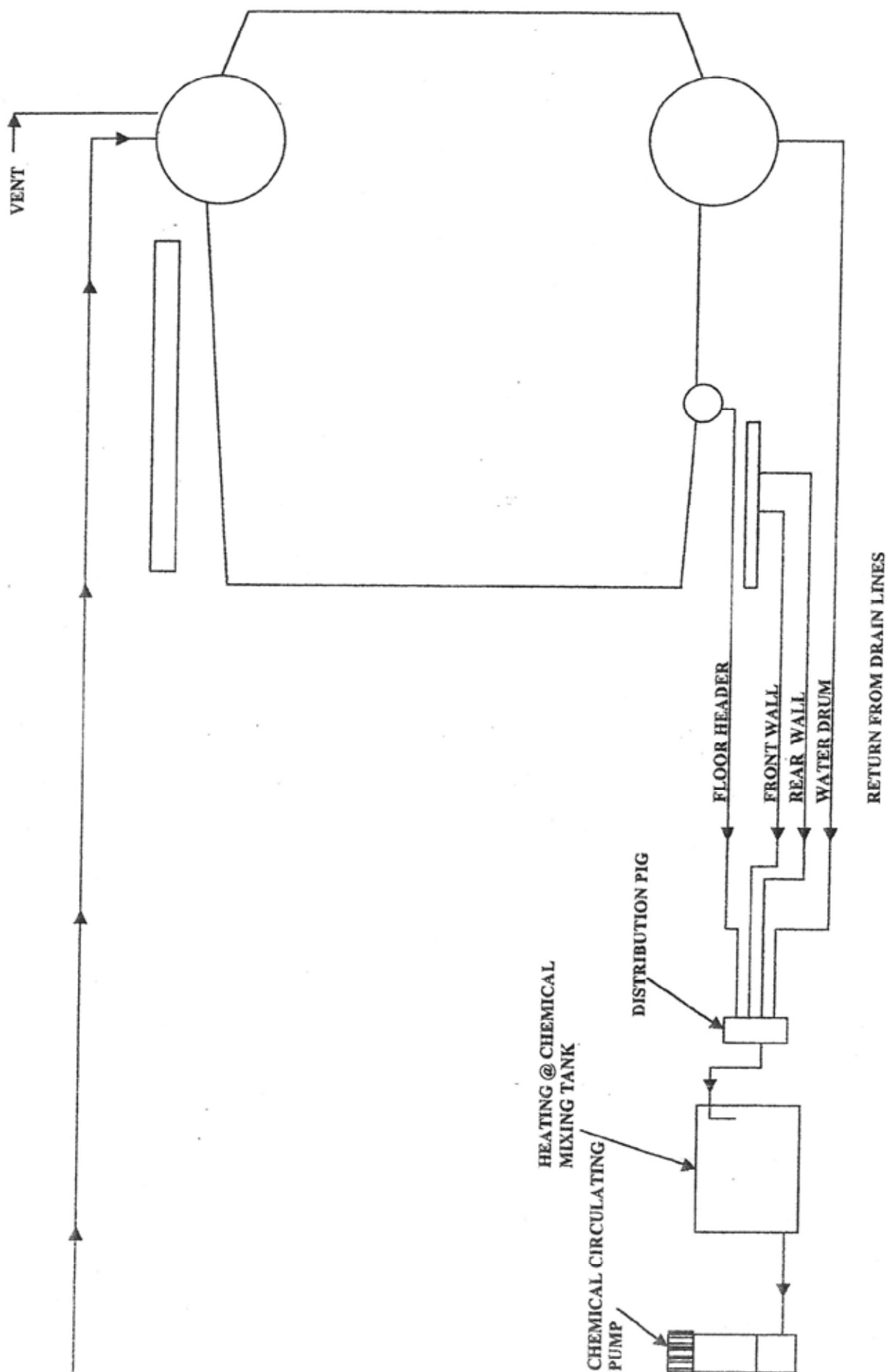
Care must be taken when returning the boiler back to service , the water level should be lowered to the bottom of the gauge and the boiler gently fired with all the vents open this will ensure the HYDRAZINE reserve is reduced to the steaming level not for getting to add the initial chemical dosage.

***PLEASE NOTE AS IN USAGE OF
ALL CHEMICALS SAFETY IS
PARAMOUNT***

**IT IS IMPORTANT THAT ALL
PERSONELL PRIOR TO ANY
CHEMICAL CLEANING READ
THE PRODUCT DATA AND
SAFETY SHEETS AND FOLLOW
GIVEN PROCEDURES**

**PROVIDED PROTECTIVE
CLOTHING SHOULD ALWAYS
BE WORN WHEN HANDLING
ANY CHEMICALS**

**THIS INCLUDES GOGGLES OR
SPLASH SHIELD, RUBBER
GLOVES AND AN APRON**



BY PYE MARINE
 RED BY DW/MARINE 10-04-03

REVERSE CIRCULATION IS
 OPTIONAL

BOILER CLEANING WORK SHEET

BOILING OUT AND ACID CLEANING

1. CHECK SUPER HEATERS ARE BLANKED OFF.
2. CHECK CHEMICAL DATA SHEETS NOTING PRODUCT REQUIREMENTS AND GIVEN TIME SCHEDULES AND TEMPERATURE NORMALLY BETWEEN 60 – 70 c.[MAX:70c]
2. FILL BOILER TO WORKING LEVEL CONNECT A HOSE TO VENT VALVE AND VENT TO ATMOSPHERE
3. COMMENCE HEATING AND CIRCULATING
4. ADD CHEMICALS AND MAINTAIN TEMPERATURE
5. PUMP OUT BOILER TO SHORE SIDE TANKER OPEN STEAM DRUM DOOR AND FRESH WATER PRESSURE WASH

BOILER CLEANING TIME CHECK

1. FILL BOILER TO WORKING LEVEL _____
2. HEAT WATER _____
3. MIX AND ADD CHEMICAL _____
4. CIRCULATE _____
5. DRAIN AND INSPECT _____
6. PRESSURE WASH AND FLUSH OUT _____
7. FILL BOILER ADD ALKALINITY TREATMENT _____
8. CIRCULATE _____
9. DRAIN AND FLUSH _____
10. FILL WITH FEED WATER TO WORKING LEVEL _____
11. HEAT WATER OR FLASH BOILER _____
12. ADD HYDRAZINE TO PASSIVATE AND CIRCULATE _____
13. DRAIN BOILER TO JUST BELOW WORKING LEVEL IF RETURNING BACK TO
SERVICE LEAVE VENT OPEN DURING INITIAL FLASHING THIS WILL ENSURE
THE HYDRAZINE RESERVE IS REDUCED TO STEAMING LEVEL. _____