

High Power Ultrasonic Technology



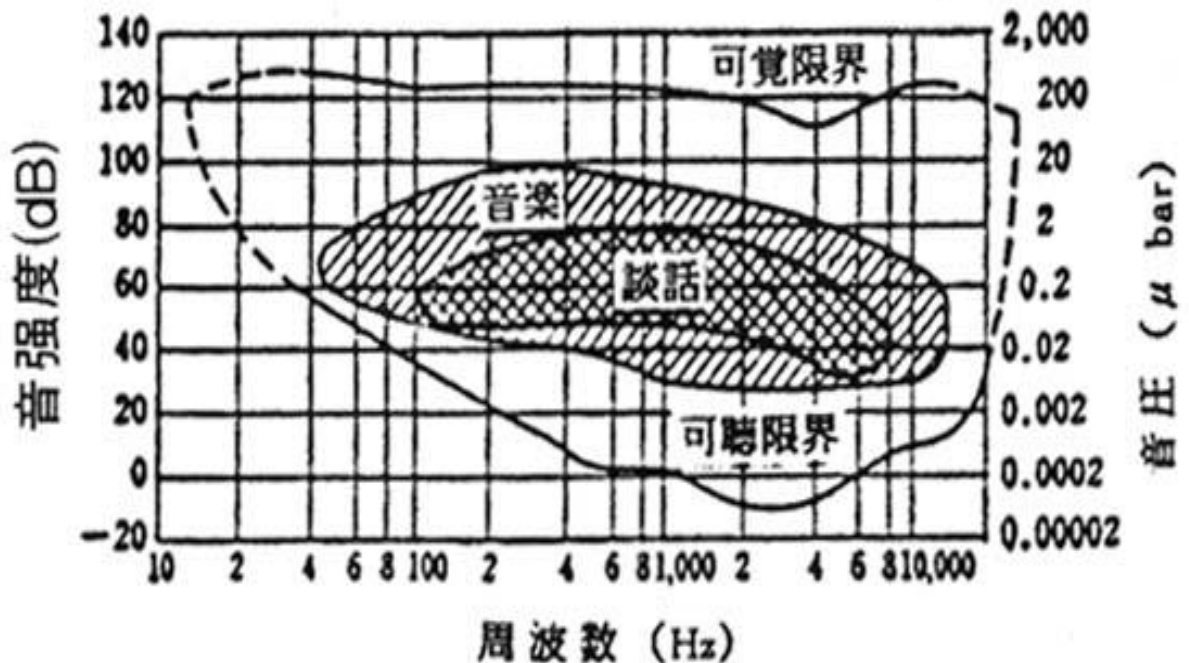
14405 Walters Rd. Houston TX 77014

Tel : 832-465-7283

<http://www.morkoamerica.com>

Ultrasound

“Ultrasound is a high tone sound which human can't hear”
Its frequency is over 20,000Hz which human's ear can't sense. Ultrasonic device is not limited at such a frequency level. For example, a dust collector which vibrates 8kHz is called to an ultrasonic dust collector. So ultrasonic device is defined irrespective of a frequency level. Now it is defined as “Ultrasound is a sound which purpose is not to be heard by human ear”



Ultrasound application

For Sensing

- Sonar
- Fish finder
- Nondestructive test
(defect of metal and structure)
- Water leakage detector
- Thickness gauge
- Current meter
- Flowmeter
- Water-level meter
- Hardness tester
- Medical device
- Back detector
- Measurement instrument to measure fouling in pipe

Ultrasound application

For Dynamic moving energy

- Ultrasonic cleaner
- Ultrasonic liquid mixer
- Vaporizer (humidifier)
- Solder
- Welder
- Processing
(Drilling, cutting, deforming)
- Compressing and extruding a pulverulent body
- Collecting dust coal
- Reforming fuel
- Collecting dust
- Aging
- Healing
- Drying

Development and application of MORKO

- Industrial cleaner
- Ultrasonic scale preventer
- Ultrasonic dyeing system(dyeing, reducing, cleaning, etc.)
- Ultrasonic bird deterrent(USP-BD)
- Ultrasonic fish deterrent device(USP-FDD)
- Reforming fuel(Research finish)
- Reforming rubber
- Environment system, degassing, etc.(On research)

Constitution of ultrasonic system

- Wave Signal Generator
- Transducer, Converter
 - Piezoelectric type
 - Magnetostrictive type
 - Polymer piezoelectric film
 - Electrostrictive type
 - Langevin type
- Booster
- Horn (Wave Guide)



Method of transferring ultrasound

◇ Continuous type

▶ Application

-Cleaner, sterilizer, welder, cosmetic device, fuel reformer, emulsion device, etc.

(→ It needs cavitation from strong ultrasound.)

▶ Advantage

-Transferring continuous wave bring dynamic energy to target.

▶ Disadvantage

- Life span of ultrasonic system is short, and it is considered of safety.

Method of transferring ultrasound

◇ Pulse type

▶ Application

– Ultrasonic scale preventer, ultrasonic dyeing system, ultrasonically reducing and cleaning a weight of fabric, ultrasonic bird deterrent, ultrasonic fish deterrent device, etc.

(→Despite small ultrasonic energy, it is sufficient to achieve a purpose.)

▶ Advantage

- Life span is long, and it has safety and can not affect a facility which ultrasonic system is installed. And it spends small electric energy, and it is possible to apply high pressure equipment.

▶ Disadvantage

- Because it has small dynamic energy, it should be considered that the method of transfer of ultrasonic energy and position of installation.

Ultrasonic Scale Preventer (USP)

With ultrasonically dynamic energy, it is used to remove and prevent scale in boiler, heat exchanger, condenser, etc.

Principle of USP

© Vibration principle

The speed of the ultrasonic waves is transmitted in order of metal , liquid , and vapor.

A machine is mostly made of metal, therefore, vibration will be transmitted to the whole equipment through metal. However, such vibration is extremely little. But we can't apply ultrasonic to Aluminum. Because surface of it be made film of oxidizing Aluminum, it is removed by action cavitation of ultrasound.

Principle of ultrasonic vibrator

Ultrasonic vibrator is used to prevent that a pulverulent body is adhered to the surface of facility by vibration at very small amplitude. So transducer should be welded to a proper position of facility, and should give a proper amplitude. To do this, frequency and time of pulse should be modulated.

The amplitude is different from the property and shape of transducer, circuit of generator, and shape of facility. And it is also consider of condition of facility.



The sand is collected a ambient shape because it is mode of vibration. The mode of vibration is different from position of transducer and frequency.

Application of ultrasonic vibrator



Installing USP to Hopper



Inside of #4 hold bin before installation



One day after installation

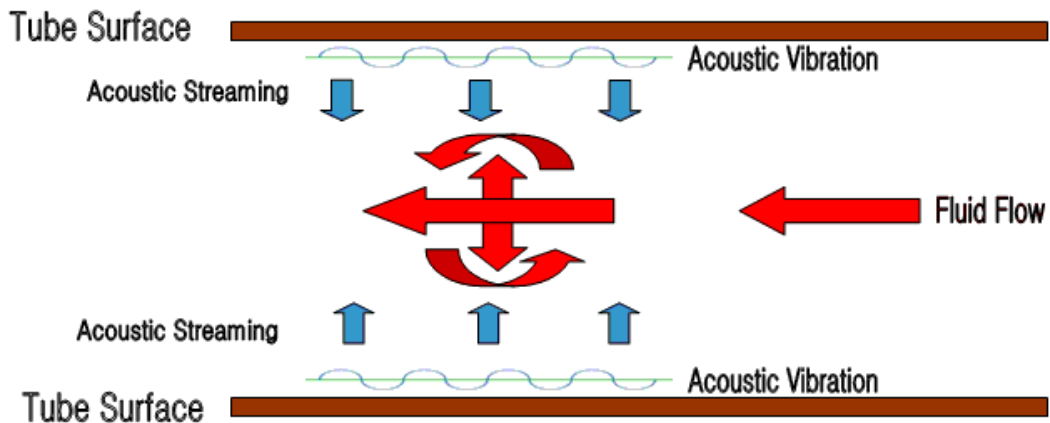


Two days after installation

Principle of USP

© Principle of wave

When ultrasonic energy is transferred to fluid through metal, acoustic radiation is generated in the fluid and also at the contact surface between the fluid and the metal. This radiates acoustic streaming into the fluid and makes convection and turbulent flow in the fluid. The acoustic streaming prevents fouling forming in the fluid and scale deposit on the metal surface. This improves heat circulation in the facilities and so enhances the efficiency of heat transmission.



Principle of USP

© Cavitation principal

When ultrasonic waves are transmitted to water through the surface of metal, many air bubbles are formed and reduced in water, and the gaseous substances in water are absorbed and exploded repeatedly,

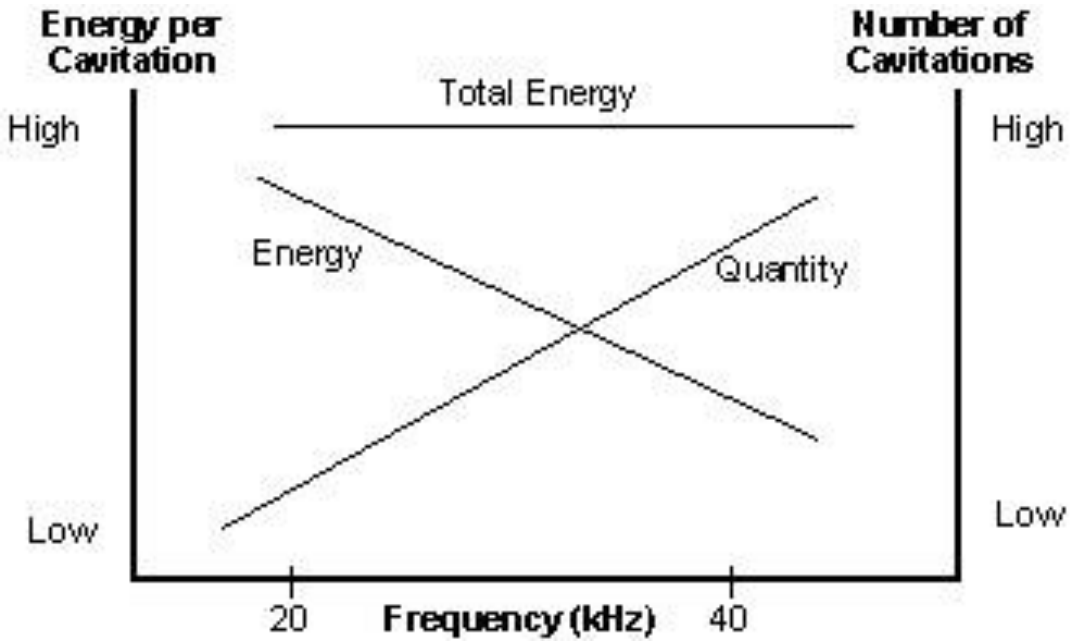
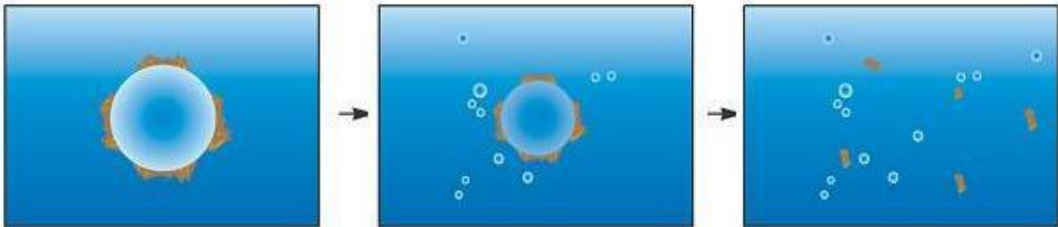
When exploded, several ten thousands of K degree temperatures are emitted, and the energy of explosion pulverize particles in water.

However, the rise of temperature is immaterial because air bubbles are so small.

We can see this through pilot test. And temperature of water rise a little in case of test long time by several principal.

The quantity of cavitation is not same for temperature and frequency of ultrasonic. As well, even if frequency is the same, the quantity of cavitation is not the same for structure and thickness of equipment.

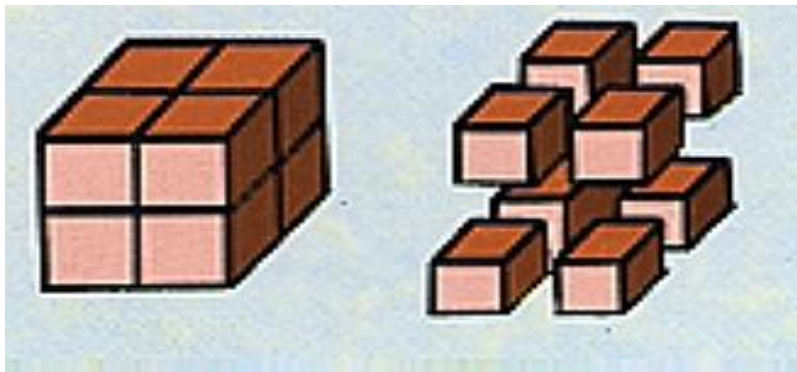
Principle of USP



Principle of USP

© Increase of surface area principal

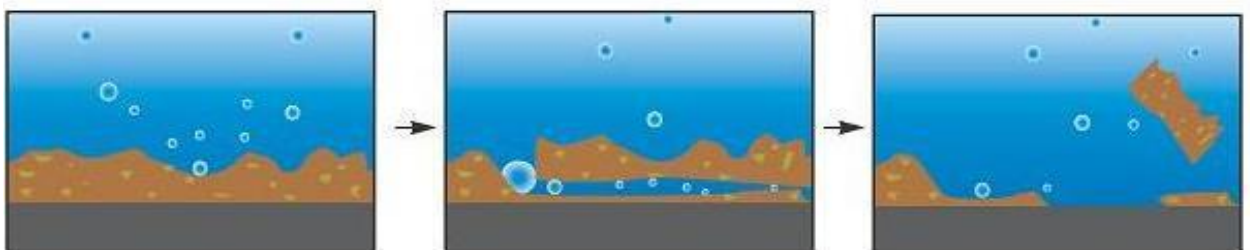
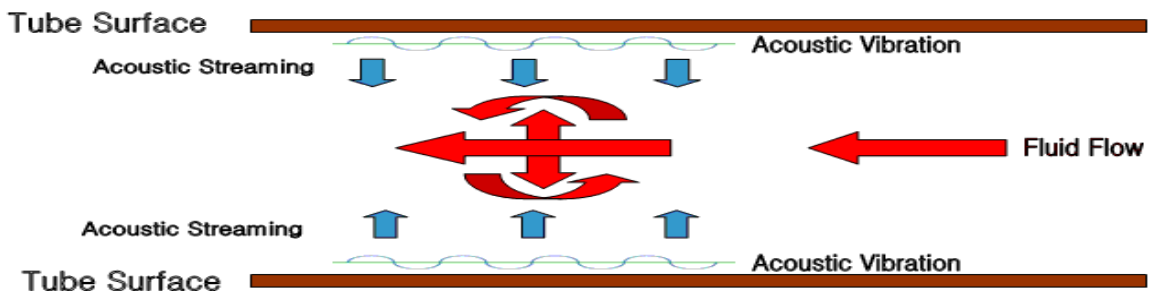
When the particles are pulverized in water, the surface area increases, and the particles are combined and pulverized repeatedly on the increased surface. Finally the particles are pulverized minutely. Cavitation and increase of surface area occurs at the same time, We can see this by pilot test.



Principle of USP

© Scale removal principal

The scale attached to the surface of metal forms a minute gap by repetition of expansion and contraction (caused by the difference of thermal expansion coefficient of matter), because heat equipment is change of temperature always. When the combination energy of Vibration, Acoustic streaming and Cavitation generated by USP acts on metal surface and in fluid, it can prevent scale deposit on metal surface and fouling forming in the fluid and further can remove preformed fouling or scale.



Principle of USP

© Other principle

Ultrasonic acts another several secondary physical and chemical principal, but effect of its is a little compare with basis principals.

When we applied to pipe line of cooling water, we could see to reduce concentration of calcium carbonate.

This is the result of above mentioned several principal

Appearance of USP



Analysis of USP

◎ Anyang factory of Nongshim

- Types of the boiler: water tube boiler 30 T/H –3units
- Types of USP: USP-900 - 6sets
- Installed date: 10 Aug. 2004
- Date of confirming effect: 24 Mar. 2005

◎ Effect

The results that USP is applied to 3 units of water tuber boiler at 30T/H are compared to confirm the effect of USP.

#1 - It is operated after chemical cleaning in June 2003, so it has scale at 1~2mm thickness. USP was installed in that condition

#2 – Installing USP after changing water tube in Aug. 2004

#5 – Installing USP after chemical cleaning in Aug. 2004

◎ Results

#2, 5 - After 4 months from installation, no more scale is adhered to boiler

#1 – Existing scale was almost removed, and rest scale was removed by high pressure cleaner.

Analysis of USP

© Laboratory of Hyundai motor company

- Types of the boiler: smoke tube packaged boiler 10 T/H
- Types of USP: USP-1000 (ACCOUSTIC POWER 15W)
- Installed date: 23 Feb 1997
- Date of confirming effect: 19 May 1997

© Effect

- This laboratory had used USP without using the chemical agents, so that this laboratory exempted the subject of control.
- This laboratory had USP installed in types of the smoke tube packaged boiler 10 T/H at first. After 3 month, This laboratory decided to install USP in the other boilers because of USP having the ability of high-effective preventing scale/humus.
 - ➔ Save the costs and prevent environmental pollution due to stopping using the chemical agents-exempt the subject of environmental control.
 - ➔ The bill of the customs due to exempting the test of boiler
 - ➔ Prevent industrial waste water which occur on testing the boiler.
 - ➔ Shorten time of stopping boiler due to shorten the test of boiler.
 - ➔ Increase thermal efficiency and save the cost of fuel due to prevent scale.
 - ➔ Extend the life of the boiler.
 - ➔ Supply high-quality steam (without using the chemical agents)
- Quote from the inside result reports of the Hyundai mote company laboratory-

Analysis of USP

© DAEWOO Heavy Industries & Machinery LTD.

- Types of the boiler: Water tube packaged boiler 3T/H
- Types of USP: USP-500 (ACCOUSTIC POWER 7.5W)
- Installed date: 4 Aug 1997
- Date of confirming effect: 21 Aug 1997(The first test date),
23 Aug 1997(The second test date),
27 Aug 1997 (Macrography on
opening the door of boiler)

Item	P H	C u	Zn	Fe	salt	SS	So 4	Na	K	Ca	Al	Sio 2	Mg
Befo re insta lling USP	8. 5	0. 02	0. 31	1.3 3	17.7	113 .7	28. 8	3. 98	1.0 2	22. 44	0.1 7	-	3.6 4
1 st test	1 0. 5	0. 02	3. 32	29. 0	117. 0	673 .2	119 .4	35 .6	15. 87	10 4.7	0.5 9	-	0.9 3
2 nd test	1 0. 7	0. 03	3. 42	26. 81	184. 4	984 .0	271 .1	98 .7 5	29. 66	11 1.6	0.6 6	-	7.3 8

◎ **Effect**

- The quality of water analysis : All the items of the quality of water measurements increase (Refer to the above table)
- PH increase
- On operating USP, Fe, Ca and Mg are the elements of scale occurring furtherance substance inside boiler pipe water. Their condensed amounts increase, so that that indicates the suppression of scale occurring and the remove of old scale.

◎ **Macrography for confirming**

- New changed boiler water pipe: No scale (New changed boiler water pipe includes the substances of rough property.)
- The existing boiler water pipe: The mass of exfoliated old scale is accumulated at the bottom of pipe. (It keeps exfoliating on conditions of sludge/scale, and then accumulating.

◎ **Conclusion**

- Although the company hasn't other treatments of waste water, USP has the effect of suppression scale occurring and remove of scale according to the quality of water analysis and macrography.
- Quote from the inside result reports of DAEWOO Heavy Industries & Machinery-

Analysis of USP

© KIA MOTORS Co., Ltd.

- Location of installation: +700 Naebang-Dong, Seo-Gu, Gwangjoo city, Gwangjoo 1 factory boiler room of KIA MOTORS Co., Ltd.
- Type of the boiler: Water tube packaged boiler 10T/H
- Installed date: 11th – 12th Oct, 2002
- Type of USP: USP-1000 (1 set)
- Date of confirming effect: 24th Feb, 2003 (14:00)
- Time of operating: During 4 months 12days

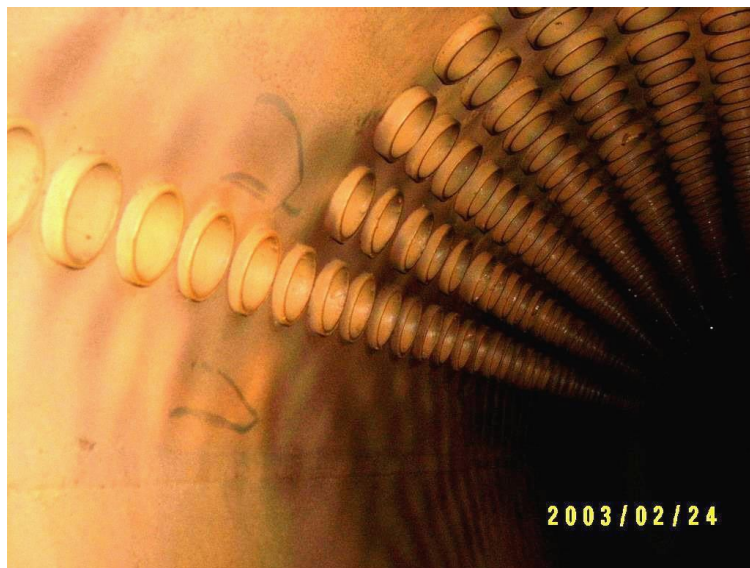
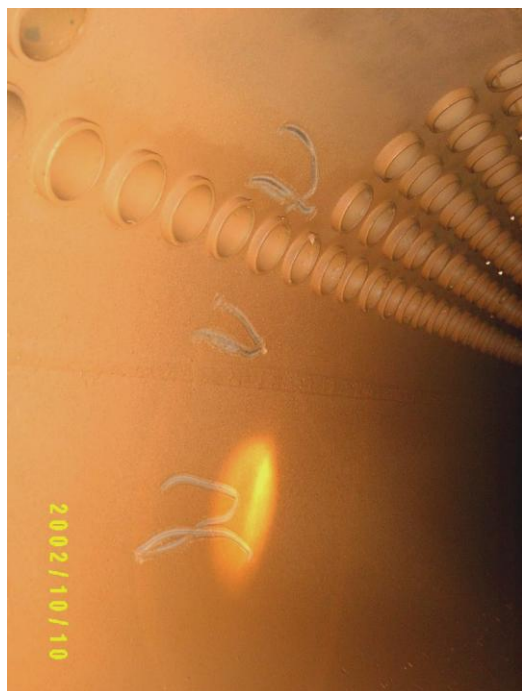
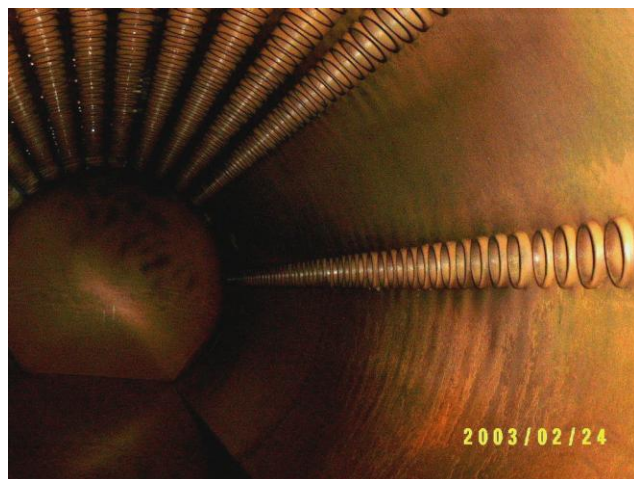
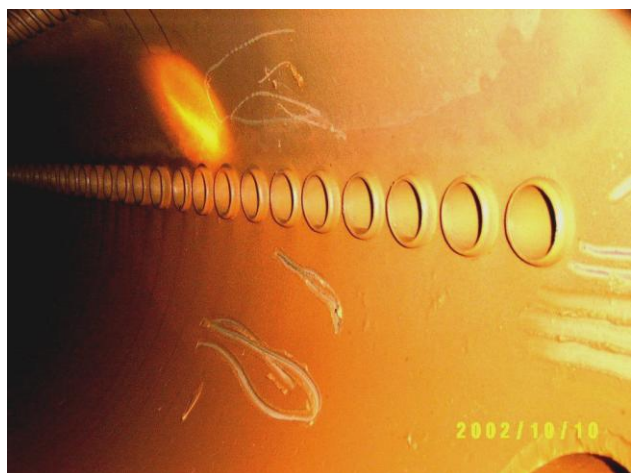
© Method of analyzing effect

- Before installation of USP, we had confirmed availability of scale inside of boiler and taken the photos. We had confirmed effect of preventing scale by examining with the unaided eye at 24th Feb 2003. After confirming effect, we had taken the photos.

© Result and Opinion of analysis of effect

- The condition inside boiler before installation USP is that scale already occurs (totally about 2mm). Opening boiler for confirmation scale after 4 months show most of scale is removed. Scale has not formed at an indicated part. So we conclude that USP is excellent about effect of preventing scale, saving energy. We decide that USP can be large installed to reduce the substance of pollution.

Analysis of USP



Before

After

Analysis of USP

◎ POSCO

- Location of installation : Boiler room, POSCO center building, Gangnam-gu, Seoul, Korea
- Type of the boiler : smoke tube boiler 5 T/H
- Installed date : 21, April, 2003 (8 days)
- Type of USP : USP-900
- Date of confirming effect : April 2004
- Time of operating : 1 year

◎ Effect

-After installing USP, boiler was operated for one year, and then confirming result by opening boiler. The result is that scale is not adhered in boiler, and it was passed in test without chemical cleaning.

Analysis of USP

© Turkey

- Location of installation : Factories in Turkey
- Type of the boiler : smoke tube boiler and others
- Installed date : Aug. 2003 & Apr. 2004
- Type of USP : USP-1000, 900, 500, 300
- Date of confirming effect : Dec. 2003 & Sep. 2004
- Time of operating : 4 months

© Effect

- Refer to picture



Before

After

Analysis of USP

© Singapore

- Location of installation : Singapore Royal hotel
- Type of the boiler : Chiller
- Installed date : 25 Sep. 2002
- Type of USP : USP-300
- Date of confirming effect : Dec. 2004
- Time of operating : 2years 3months

© Effect

- USP has a good effect for prevent scale, so USP were installed to other chillers. (Feb. 2005)



Analysis of USP

- Flue Smoke Tube Boiler -



- Water Tube Boiler -



Actual sales of USP

Oil Refinery field

Company	Application
GS-Caltex Corporation	Oil refining facility[CDU(Crude Distillation Unit) & Piping]
SK CORPORATION	Oil refining facility[CDU(Crude Distillation Unit) & Piping]
HYUNDAI OILBANK CORPORATION	Oil refining facility[CDU(Crude Distillation Unit) & Piping]
S-Oil Corporation	Oil refining facility[CDU(Crude Distillation Unit) & Piping]
Samsung Fine Chemical Co., Ltd.	Heat Exchanger, etc.
Kumho Mitsui Chemicals, Inc.	Piping in Process, etc.
KUMHO P&B	Heat Exchanger, etc.
SKC	Re-Boiler in Process
DEOKANG ENERGEN CORPORATION	Gas Condenser(Cooling Water)
Korea Carbon Black Co., Ltd.	Pipe for transferring Carbon Black(Particulate material)
Korea Kumho Petrochemical Co., Ltd. (Yeosu Combined Heat & Power Plant)	Air cooler
HU-CHEMS Co., Ltd.	Heat Exchanger, etc.

Foreign countries

France	Boiler, Piping, etc.
Turkey	Boiler, Dyeing facility, etc.
Singapore	Chiller for air conditioning in hotel(Cooling water)
Guam	Boiler
Czech Republic	Plate Heat Exchanger, Boiler
Bangladesh	Ultrasonic Fish Deterrent Device(USP-FDD)
Taiwan	Heat Exchanger, etc.

Actual sales of USP

Industrial field

Company	Application
POSCO(POSCO CENTER)	Flue Smoke Tube Boiler, etc.
NONGSHIM(Anyang Factory, Gumi Factory)	Water Tube Boiler, etc.
HYUNDAI MOTOR COMPANY(Namyangju Laboratory)	Flue Smoke Tube boiler & Water Tube Boiler, etc.
KIA MOTORS CORP.	Water Tube Boiler, etc.
GM DAEWOO AUTO & TECHNOLOGY COMPANY	Water Tube Boiler, etc.
ULSAN CHEMICAL CO., LTD.	Flue Smoke Tube Boiler, etc.
WOONGJIN FOODS Co., Ltd.	Flue Smoke Tube Boiler, etc.

Laboratory

Name	Application
Korea Electric Power Research Institute	Research & Experimental Device
Korea Research Institute of Bioscience and Biotechnology	Experimental Device
Korea Institute of Science and Technology	Experimental Device
RESEARCH INSTITUTE OF INDUSTRIAL SCIENCE & TECHNOLOGY	Experimental Device
GYOUNGSANG NATIONAL UNIVERSITY	Experimental Device
Toray Saehan Inc.	For a Mixture of Chemicals
PYUNGHWA SPECIAL RUBBER CO., LTD.	For Improving the quality of rubber, etc.

Comparison between thickness scale and Loss rate of fuel

Date of Korea Energy Management Corporation (KEMCO)

Thickness of Scale [mm]	0.5	1	2	3	4	5	6
Loss rate of fuel [%]	1.2	2.2	4.0	4.7	6.3	6.8	8.2

Data in Europe and China

Thickness of scale [mm]	0.5	1	2	4	8	16	30
Loss rate of fuel [%]	2	4	6	10	20	40	80