



**CORROSION
PREVENTION &
REMOVAL
SYSTEMS**



ENAMX CPDS APPLICATION CASE STUDIES

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PREFACE

Enmax Corrosion Prevention and Removal System (CPRS) is a complete series of the tools used for the prevention and removal of scale, paraffin, asphaltene deposits and rust in oil and gas industry and any heat water and cooling water systems in other industries.

CPRS is comprised of nine dissimilar metals as Copper, Zinc and Nickel, etc., which can form a special catalyst to enable a change in electrostatic potential, and produces a polarization effect on the liquid molecular or minerals, thereby suspending solids and inhibiting the formation of scales, paraffin and corrosion.

Enmax Technology (Shanghai) Company, Ltd. has been dedicated during last ten years in promoting CPRS technology and manufacturing CPRS products, and has achieved a great success in helping all the customers to solve the most troublesome problems with paraffin, scale and corrosion.

Out of the thousands of CPRS application histories, in this literature we have collected 20 case studies from oil and gas industry and also 16 case studies from petrochemical, chemical, iron and steel, electric power, paper, and food industries, which could be used for your reference in selecting the applications and the CPRS units.

Enmax Technology (Shanghai) Company would like to express our thanks to all the customers who provided all the case study data and the performance reports of our CPRS units.

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SECTION 1 OILFIELD PARAFFIN, SCALE AND CORROSION SOLUTIONS

CASE NO. 1 CRUDE TANK BATTERIES, TEXAS, USA

Operator: Armstrong Oilfield Services, Kilgore, Texas

Before the installation:

Hot oiling flowline and downhole every 30 days, running heaters at 135 deg, rolling tanks before the hauls and selling the oil at a BS&W count of 2.

Paraffin and scale throughout the entire system

After the installation on May 1, 2000:

June 1, 2000: Flowlines and separators cleaned up. Prior to this, separators had to be bypassed due to paraffin. BS&W fell down to 0.5 –0.1. No hot oil treatment and no rolling tank to sell oil

June 15: All shakeout has no paraffin, only corrosion from the inside walls of the tank.

July 7: Inspection showed that all surface equipment was clean. Noted the sight glass on the separators was clean, which had never been to be read before.

CASE NO. 2 PARAFFIN WELLS AND FLOWLINES, EAST TEXAS, USA

Operator: Exxon Mobil Oil Company

Location: East Texas Oilfield, 2 worst paraffin producing wells

Before installation:

The wells were being hot oiled (tubing and flowline) in the winter months on a weekly basis.

Two years after installation:

The wells have not required any hot oiling ever since.

CASE NO. 3 WATER FLOOD TANK BATTERY, TEXAS, USA

Location: Woodlawn Oilfield, Harrison County, Texas, South Tank Battery, 265 bbls/day

Before the installation:

Filters were changed every six days and chemicals were used daily.

30 days after installation:

Filters were changed for the first time. No chemicals were being used.

CASE NO. 4 PARAFFIN WELL H16-7, CHANGQING OILFIELD, CHINA

Location: Well H16-7, Wangnan Operation Base, Changqing Oilfield, CNPC/PETROCHINA

Before installation:

Serious paraffin problems, one hot oil treatment every month.

After installation:

A downhole tool was installed In July, 2003.

September 15, 2002: No hot oil treatment was done and no pump repair job. The maximum rod load and maximum current of the motor were obviously dropped than before the installation.

July 2004: One year downhole operation without any problems, no hot oil treatment, no chemicals and no pump repair.

Well H16-7 Data Sheet											
Well produced Date		Anti-Wax unit		Installation Date		Installation Depth of CPRS		Description			
Nov.2. 2000		Enmax CPRS		July 5. 2003		993.73m		CPRS downhole unit was installed on July 5th, 2003 after hot oiling			
Before installation											
Date	Produced days	Fluid (m ³ /day)	Crude (t/day)	water%	Fluid level (m)	Working status	Max rod Load (KN)	Min rod load (KN)	Up stroke max amps	Down stroke max amps	Notes
Aug. 2002	31	12.16	2.19	80.1	547/441	OK					Aug.6 Workover
Sept. 2002	29.9	11.60	2.07	78.7	420/568	OK					Sept.8 Hot oil
Oct. 2002	30.7	11.99	2.12	79.1	402/586	OK					Oct.14 Workover
Nov. 2002	29.8	11.74	2.32	76.6	518/470	OK					Nov.16 Hot oil

Dec. 2002	31	10.77	2.35	74.3	532/456	OK						Dec.10 Hot oil
Jan. 2003	31	10.75	1.9	79	523/465	OK						Jan.17 Hot oil
Feb. 2003	28	10.93	1.86	79.7	498/490	OK						
March 2003	31	11.12	1.84	80.3	440/524	OK						Mar.5 Hot oil
April 2003	29.7	11.43	2.02	79.0	389/575	OK						Apr.17 Hot oil
May 2003	31	11.34	1.94	79.7	470/494	OK						May 22 Hot oil
June 2003	30	11.33	1.57	83.5	488/476	OK						
July 2003	30.7	10.54	2.57	71.0	505/458	OK	26.29	7.91	17	14		July.18 Workover
Pump inspection frequency: 237days; Paraffin frequency: 30 days.												
After installation												
2003.8.12		10.38	2.08	76.2	480/483	OK	28.30	10.49	14	13		
2003.8.25		10.25	2.14	75.1	451/512	OK	28.16	10.12	13	12		
2003.9.2		13.94	3.10	73.5								
2003.9.3		12.54	1.99	81.1								
2003.9.12		10.54	2.23	74.8	455/508	OK	27.45	10.21	13	11		
2003.9.13		10.54	2.57	71.0								
2003.9.19		11.66	2.78	71.6								
2003.9.22		14.33	2.77	77.0	424/539	OK	27.07	9.51	14	12		
2003.9.23		14.79	3.27	73.7								
2003.9.25		12.86	2.84	73.7								

2003.9.28		12.80	2.61	75.7							
2003.9.29		12.26	1.43	86.1							
2003.10.3		12.54	1.71	83.8	416/547	OK	26.52	9.22	14	13	
2003.10.9		12.54	1.58	85.0							
2003.10.12		12.06	1.52	85.0							
2003.10.13		12.06	1.30	87.2							
2003.10.18		12.06	1.21	88.1	447/516	OK	29.12	12.86	13	9	
2003.10.25		11.66	1.95	80.1							
2003.10.3		9.45	1.21	84.8							
2003.11.3		9.45	1.11	86.0	464/499	OK	28.46	10.04	13	10	
2003.11.8		9.45	1.20	84.9							
2003.11.12		11.37	1.44	84.9							
2003.11.15		13.13	1.31	88.1							
2003.11.18		13.13	1.62	85.3			28.46	11.04	13	11	
2003.12.4		10.67	1.67	81.4	462/501	OK	28.96	9.57			
2003.12.8		10.67	1.85	79.4							
2003.12.13		11.35	1.81	81.0							
2003.12.18		11.35	1.44	84.9	466/497	OK	27.00	10.79	18	15	
2004.1.8		11.42	1.46	84.8	419/553	OK			17	15	
2004.1.9		11.18	1.43	84.8			28.60	11.04			

2004.1.10		11.26	1.44	84.8							
2004.1.12		11.61	2.24	77.0							
2004.1.18		11.61	1.59	83.7			28.81	11.12			
2004.1.23		11.61	1.41	85.5	438/534	OK					
2004.1.25		11.55	1.41	85.5							
2004.1.28		11.55	1.43	85.3							
2004.2.4					394/578	OK					
2004.2.12		11.4	1.22	87.3			27.11	10.76			
2004.2.19					378/594		26.95	8.87			

CASE NO. 5 HIGH ASPHALTENE AND HIGH POUR-POINT AND CRUDE, CHINA

As the third largest oil field in China, Liaohe Oilfield, CNPC/PETROCHINA has a reputation for thick oil, ultra-thick oil and high pour-point crude oil production, and the highest solidification temperature goes up to 67 deg. C.

AN 20-23 WELL

Before t installation:

This well produced at 23 M³ / day, 5.7 M³ / day of crude oil, 75% of water, 37-38.5% of paraffin, 12-15% of gel, with solidification temperature of 54 deg C, one of the typical heavy oil wells. Electric heating system was used to heat the crude to 90 deg C for the crude to flow.

After the installation:

A CPRS downhole unit was installed on Feb. 05, 2005, no electric heating for the first three months, and three month after, one electric heating every ten days.

H75-4-4 WELL

This well is a high asphaltene crude oil well, 24 hr heating was used to keep the flow. After the CPRS was installed, no more production tubing heating was required, which reduced the extremely expensive heating cost by electricity.

H75 WELL

This well was treated with hot oil on a basis of a time per month. After the CPRS installation, the well have been producing for 425 days without treatment.

N74-14-14 WELL

This well required a hot oil treatment every two months; however, it has been producing for 520 days so far successfully after the CPRS installation.

Q31-49 WELL

This well was treated with hot oil, and then a CPRS unit was installed for replacement. 168 days after the installation, the pumping rod was broken, it was noticed there was no paraffin and no any other deposits on the pumping rod and pump when the downhole string was pulled out of the hole. The same CPRS unit was run into the well with downhole string, and has been producing 110 days so far without any problems.

CASE NO. 6 PARAFFIN WELLS, ARTIFICIAL ISLAND, CHINA

Location: Well NP 109 and Well NP1-29X112, Artificial Island, Jidong Nanpu Oilfield

Operator: Jidong Oilfield, CNPC/PETROCHINA

CPRS unit: 2-7/8" Downhole tools

Before installation:

- This artificial island has 29 wells in total, and 15 wells were opened for production, with a daily fluid production rate of 563 tons, of which 508 tons of crude and 9.7% of water.
- The crude are of high paraffin content and chemicals were used to treat paraffin problems due to limited working space.
- Well NP 109 and Well NP1-29X112, which had serious paraffin problems, were selected to test ENMAX CPRS units.

After installation:

- The CPRS units were installed in December, 2009.
- Well NP 109 was not able to produce because of paraffin plugging off. After the installation of CPRS units, the well has been producing stably without any paraffin problems.
- It also been noticed after the installation that the surface chokes had no paraffin deposit at all, which were quite often been plugged off before.
- The driven electric motor amps were very stable.

CASE NO. 7 HIGH PARAFFIN WELLS, NIGERIA

Location: IMO River-59T, Nigeria

Operator: Shell Oil

Before the installation:

- The potential production rate: 4000 BOPD and serious paraffin problems
- The production rate was less than 1000 BOPD
- The well has not produced for more than 2 months at single stretch
- A number of remedial actions were not successful
- Traditional chemical treatment required a pump at wellhead and brought up disposal and environmental challenges.

After the installation:

- De-waxing efficacy was proved a few days after
- The production rate increased to 3800 BOPD
- The well produced for 90 days non-stop
- Over 50% in cost savings in comparison with traditional treatments
- 15 systems were to be installed after the success
- Senior Production Technologist Mr. Chiji Onwuzurike called it "a significant breakthrough in de-waxing operations in our wells".

MAY 2009 DRUGGERS IN THE MARKET

We're winning the war on wax

Application of cutting edge technology in the business has continued with the employment of a new de-waxing system in Eastern operations which pushed up production to high levels.

Silver Hawk, a wax inhibition tool installed downhole in Imo River-59T, where wax problems (deposits of paraffins and other solids) started to reduce production at less than 1,000 barrels of oil per day (bopd.) It freed up the well to produce 3,800 bopd. Senior Production Technologist Chiji Onwuzurike called it "a significant breakthrough in de-waxing operations in our wells."

Like the average water pipe that gets clogged up with scales and brine, pipelines fall victim to solidification which reduces and sometimes completely blocks the flow of oil. The problem was particularly acute at Imo River-59T, which since its completion in 1999, had not produced for more than two months at a single stretch. The well had a potential of 4000 bopd at the time it was filled.

Chiji explained: "We examined

and implemented a number of remedial actions which were marginally successful. The traditional treatment of wax using chemicals to disperse the paraffins will require installing a pump at the wellhead and the chemicals would bring up disposal and environmental challenges.

"Besides, the installed equipment left at the well head might be vandalised or stolen."

The Silver Hawk option was most attractive in terms of simplicity and cost. An alloy composed of dissimilar metals, Silver Hawk stops the formation of scale deposits by changing the physical properties of crude oil and preventing bonding.

It is installed downhole where the oil passes through it before getting to the flowline.

At Imo River-59T, Silver Hawk was deployed last November on a "no-cure no-pay basis", and a few days after, it proved its efficacy in de-waxing. The well produced for 90 days non-stop.

Chiji said: "To further help in the de-waxing operation, we had replaced the steel flowline with Glass Reinforced Epoxy (GRE); a special pipe that stops the internal of the pipeline from losing heat so that



We're waxing stronger in the war on wax: Chiji Onwuzurike says paraffin does not form.

This amount translates to over 50% in cost savings, when compared to the cost of procuring chemicals and equipment to de-wax wells conventionally.

The plan is to install the device in 15 wells where wax problems have hindered oil production.

CASE NO. 8 PARAFFIN AND CORROSION WELLS, TEXAS, USA

Operator: Austral Oil Company

Location: Danielle-Quinn, Jefferson County, Texas

Installation Date: Dec. 2001, downhole unit

Prior to installation:

- Have to pull this well every 3 months for corrosion and paraffin problems
- Had to hot oil and change out the pump

From installation to Jan. 2003:

- Never pull the well
- No hot oil treatment had been done because the rods were paraffin free
- No pump change out because there was no pump corrosion and the only thing did was to change the ball and seat
- Savings from replacing pumps and rods, hot oil treatment, workover time totaled at approximately US\$29,540.20

CASE NO. 9 HIGH PRESSURE GAS AND CONDENSATE WELL, LA., USA

Operator: Austral Oil Company

Location: Gooch # 2 and #3, Vermillion Parish, LA

Installation Date: May, 2001

Installation Depth: 3000 ft

Prior to installation:

- Cut paraffin every 30 days at a cost of US\$10,500 for each well.
- Paraffin contents in the condensate was 14.7%.
- High pressure with flowing tubing pressure of 8,000 psi

After installation:

- No need to cut paraffin.
- Within two years, approximately US\$120,000 was saved for each well
- No loss of production in either well.

CASE NO. 10 SCALE PROBLEMS IN WATER INJECTION WELL, EAST TEXAS, USA

Location: East Texas, Salt water Injection well

Installation Date: March 5, 2001, 8" surface unit

Before installation:

- Severe Calcium Carbonate scale, using 4 gallons of BAKER SCW0026R chemical treatment per day.
- injection pressure was 425 psi with injecting rate of 22,000 bbls/day

71 days after installation On May 15, 2001 :

- No chemicals had been used after the installation.
- Pressure at injection well has maintained at 400psi, down from 425-430 psi prior to installation.
- Transfer line pressure dropped from 70 psi to 55 psi.
- Side wall of clear Tank began to clear up.
- Suction cap on Gardner Denver injection pump had no additional scale buildup.
- Only maintenance was a one-time cleaning of the interior plates.

CASE NO. 11 BA, SR SCALE, CNOOC BOHAI, CHINA

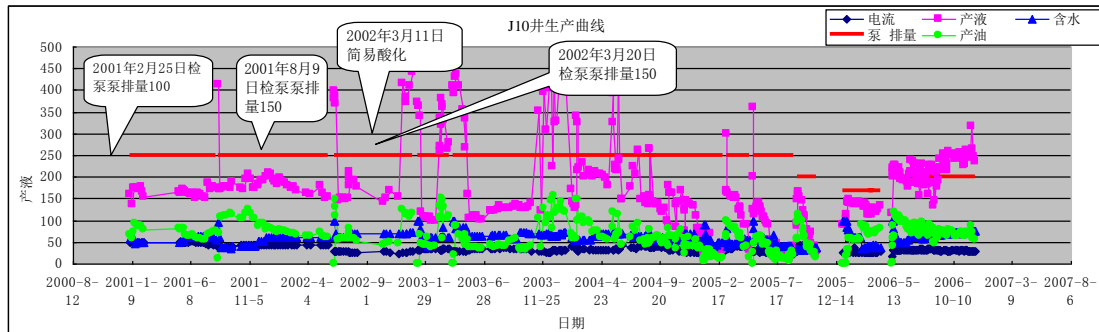
Location: Well No.: SZ36-1-J10, SZ36-1 Platform

Operator: CNOOC Bohai Oil Company

Before installation:

- Production started on Dec. 14, 1997 with ESP. ESP capacity is 100m³/d. The well was initially produced with 12.7mm choke at 1.2MPa, with a rate of 92.9 m³/d, and crude 85.5m³/d.
- This is a high production well, and the oil production was stabilized above 100 m³/d after acidizing in 1998.
- Since 2005, the electric current and daily production started to drop down to below 30m³/d. A new EPS was replaced on March 3, 2005 to produce at an initial rate of 155m³/d, and stabilized at 130m³/d, however in mid April the production dropped a lot and the pump stopped on May 6, 2005 due to overloading.
- Pump was inspected on May 13, 2005 and noticed that the pump was stalled due to scale buildup on spine, pump suction and inside the pump.
- After pump repairing, the initial production went up to 130m³/d again, but the production dropped to 42m³/d in a short time.
- A pump inspection was done on August 30, 2005, and it is noticed that a lot of scale built up on the surface of the pump protector, which caused the failure of the protector.
- A magnetic scale tool was run into the well, but it did not work, with a initial production of 86.1 m³/d and a peak rate of 166m³/d, but the rate dropped to 25m³/d, and the pump was stalled by overloading on Oct. 27, 2005.
- Pump was repaired on Nov, 10, 2005 and produced at 150m³/d, on Dec. 31, 2005 at rate of 168m³/d, and on Jan. 8, 2006 with a production of 168m³/d. The pump was stalled again on April 7, 2006 after three month operation.
- It was concluded that such a frequent pump inspection and repair was mainly caused by the downhole scale buildup, which resulted pump failure and reduced production.

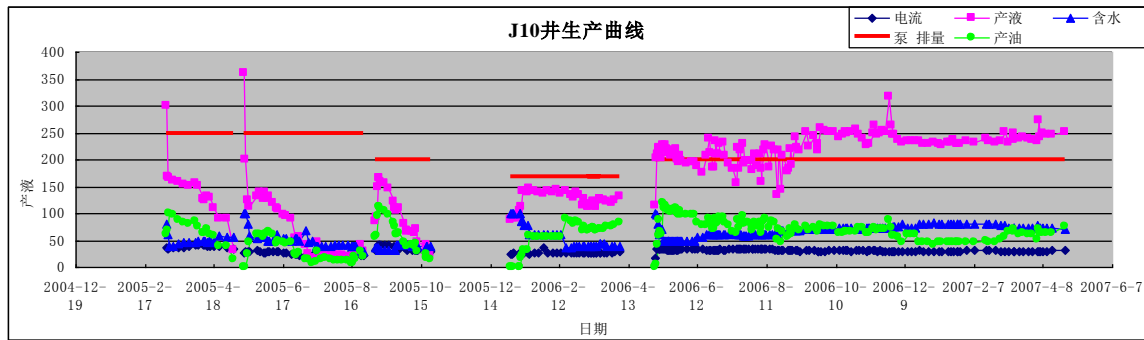
- After scale analysis, it is noticed that the scale is Ba and Sr scale, which is really difficult to prevent and remove.



After installation:

- After the pump repair on May 4, 2006, A Enmax CPRS downhole tool was run into the well with the pump.

- By the end of our tracking date on October 16, 2008:
 - The pump was maintenance-free from an average servicing frequency of 80 days
 - The production has been stabilized for a continuous period of 892 days without any production stopping.
 - A pump maintenance cost of 150,000.00 USD was saved.
 - A production increase of 270,000.00 USD.



中海石油(中国)有限公司 天津分公司生产部

SZ36-1 J10井生产管柱图

序号	名称规格型号	外径(m)	内径(m)	长度 (m)	顶深 (m)
1	油补距	X	X	15.26	0.00
2	油管挂(3-1/2"EUE B×B)	11.000	2.992	0.29	15.26
3	双公短节(3-1/2"EUP×2-7/8"EUP)	3.500	2.441	0.20	15.55
4	2-7/8"EUE 油管124根	2.875	2.441	1205.02	15.75
5	泄油阀	3.500	X	0.15	1220.77
6	2-7/8"EUE油管1根	2.875	2.441	9.63	1220.92
7	泵头及变扣	3.860	2.441	0.14	1230.55
8	潜油泵	3.860	X	5.35	1230.69
9	分离器	3.860	X	0.76	1236.04
10	保护器	3.860	X	3.40	1236.80
11	电机	5.400	X	3.74	1240.20
12	扶正器	5.900	X	0.57	1243.94
					1244.51
13	丢手下体	3.740	2.598	1.93	1381.20
14	3-1/2"EUE油管短节	3.500	2.992	1.02	1383.13
	变扣	3.500	2.992	0.20	1384.15
15	定位器	4.500	2.992	0.27	1384.35
	定位密封段	4.000	2.992	0.86	1384.62
16	变扣	3.268	2.441	0.48	1385.48
	防窜装置	3.504	x	0.62	1385.96
	2-7/8"NU油管薄接箍	3.189	2.441	0.13	1386.58
17	变扣2-7/8"EUP×NUB	3.700	2.441	0.10	1386.71
	2-7/8"EUE油管(无接箍)	2.874	2.441	9.50	1386.81
	2-7/8"EUE油管	2.874	2.441	9.64	1396.31
18	变扣2-7/8"EUB×NUP	3.661	2.441	0.12	1405.95
	2-7/8"引鞋	3.189	2.441	0.13	1406.07
					1406.20
19	电缆				
A	BAKER 7"SC-1R 封隔器	5.82	4.00	1.44	1384.62
B	BAKER 7"SC-1L 封隔器	5.86	4.00	1.44	1476.89
C	BAKER 7"底部封隔器	4.75	2.99	0.40	1536.10
D	人工井底				1620.00
电 潜 泵 机 组 参 数					
厂家	北京东晟	实际运行情况			
额定排量	150m ³ /d	产液		/	
额定扬程	1300m	运行电流		33A	
额定电压	1141V	运行电压		1190V	
额定电流	48A	启泵压力		10MPa(仍有上升趋势)	
电机功率	70KW	启泵时间		2006-05-06 12:00	
地面控制设备情况: 良好					
井下落物情况: 无					
压井液类型: 地层水				压井液比重: 1.000	
采油树情况描述: 试压1000Psi×10'合格。					
以上深度均以原钻井船转盘上平面为基准面					

修井队长: 李勇

修井监督: 刘东明、文权

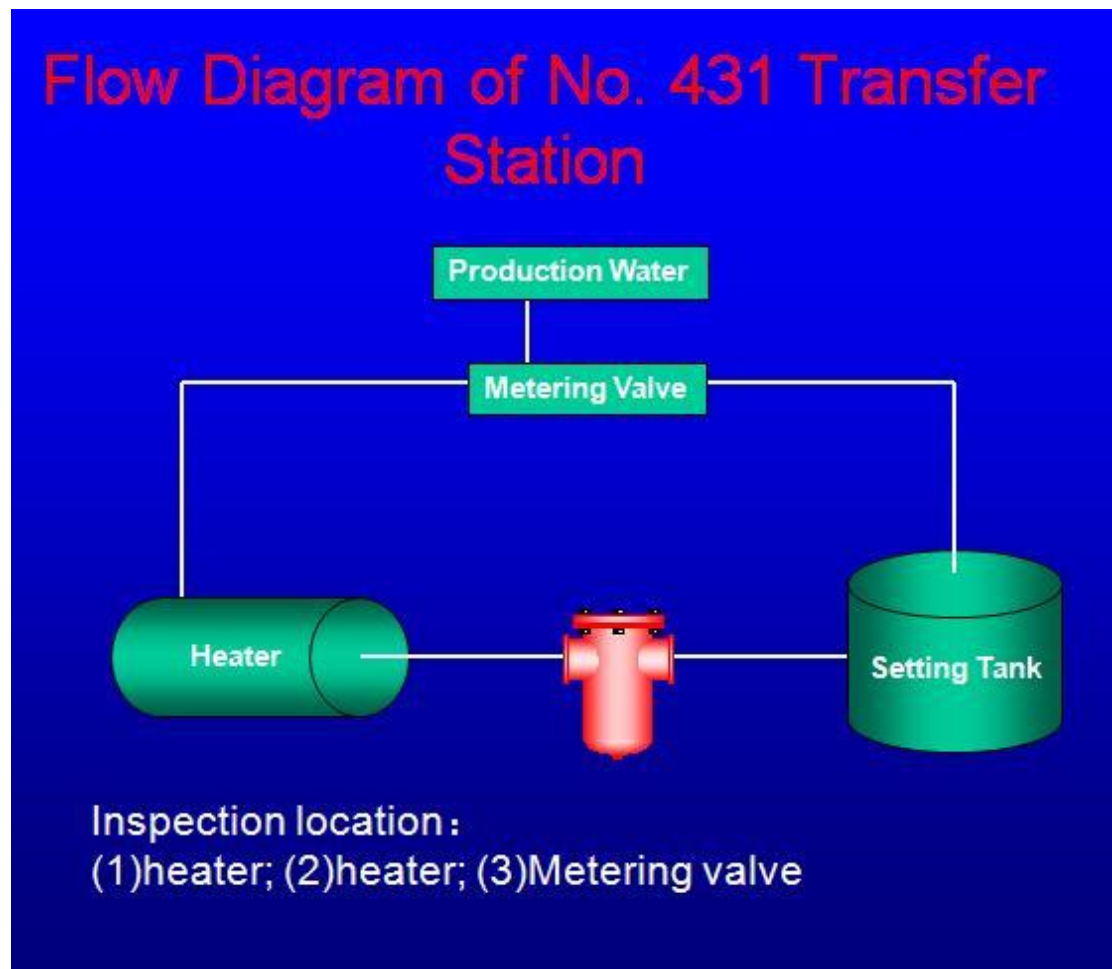
日期: 2006年5月6日

CASE NO. 12 PRODUCTION WATER SCALE, TRANSFER STATION, DAQING, CHINA

Location: No. 431 Transfer Station

Operator: Daqing No. 6 Production Company

Installation Diagram:



Before and after installation:

- Before the installation, the scale thickness at the outlet was 2.5cm hard scale, it was reduced to 0.8 mm when inspected on June 20, 2005, and reduced to 0.4 cm on Sept. 23, 2005.
- Before the installation, the scale thickness at the inlet was 4mm, there was no more scale buildup on June 20 and Sept 23, 2005 for inspection.

Location	Before Installation		7 Months After	9 Months After	7 months	9 months		
Heater inlet	4 mm	Very hard	0	Crispy	0	No	-4 mm	-4 mm
Heater tubes	7 mm	Very hard	2.5	Crispy	1	Crispy soft	-4.5 mm	-6 mm
Metering valve	7 mm	Very hard	1.5	Crispy	0		-5.5 mm	



CASE NO. 13 POLYMER FLUID SCALE, DAQING OILFIELD, CHINA

Location: Zhongxin No. 201 Transfer Station

Operator: Daqing No. 1 Production Company

- A six month test was done on Enmax CPRS surface units by Daqing Oilfield Designing Institute and Daqing No. 1 Production Company for polymer fluid scale prevention and removal performance evaluation.
- The scale thickness in the heaters was about 20 mm, some scale are old scale deposits due to uncompleted cleaning jobs.
- Four surface units were installed on Jan. 5, 2006 at the inlets of four heaters at Transfer Station No. 201 of Daqing No. 1 Production Company.
- Chemical additives were stopped on March 17.
- Six months after the installation, the tools were inspected on June 14, 2006, and the tubes of No. 2 heater were pulled out for inspection.





CASE NO. 14 TRANSFER STATION 4-2, POLYMER SCALE, DAQING OILFIELD, CHINA

Location: Transfer Station 4-2

Operator: Daqing No. 2 Production Company



**CASE NO. 15 WASTE WATER TREATMENT STATION, SHENGLI OILFIELD, CHINA**

Location: Shengli Oilfield, Sinopec, China

Before installation:

Very hard and consolidated scale

**Three months After installation on August 28, 2007:**

The scale became softer as slurry and it can be scraped off with hands, and there was no new deposit noticed inside the flowline.



CASE NO. 16 WASTE WATER DISPOSAL FLOWLINE, OFFSHORE PLATFORM, CHINA

Location: Panyu Oilfield, Nanhai East, CNOOC offshore platform, China

Application: Scale prevention and removal

**CASE NO. 17 IRON SULFIDE CORROSION PROBLEMS**

Operator: T.M. Hopkings H75 Well

This well was treated with hot oil a time per month, after the CPRS installation, the well have been producing for 425 days with any downhole treatment. Operating Co.

Location: Hugoton Field Stratford #1, Sherman County, Texas.

Produced from the Brown dolomite formation at approx. 3200 ft. Low bottom hole pressure and rod pumped to produce the gas.

Before installation:

Serious Iron Sulfide problems plugged off perforations and corroded downhole pumps.

With Iron Sulfide problems, as time goes, pump efficiency decreases and pumping time has to be lengthened, more wear and tear on pumps. one hour on and 2 hours off.

After the installation in Nov. 2000:

No pump efficiency problem and amount of on time was reduced. Pumping 15 min out every 3 hours and produced 46 MCF/day and ½bbl water.

CASE NO. 18 NATURAL GAS PROCESSING STATION, FUSHAN OILFIELD, CHINA

Location: Gen set cooling system, Fushan Oilfield Natural Gas Processing Plant, Hainan, China

Application: Scale prevention and removal



CASE NO. 19 WATER NETWORK OF OIL/GAS SEPARATOR, XINJIANG OIL FIELD

Location: Kelamayi, Xinjiang Oilfield

Application: Scale prevention and removal

Before installation:

- The water flowlines for the oil/gas separators in the crude processing station had a layer of .3cm hard scale buildup every year.

- Acid cleaning jobs could not achieve the expected results. Which increased the production cost and downtime.

After installation:

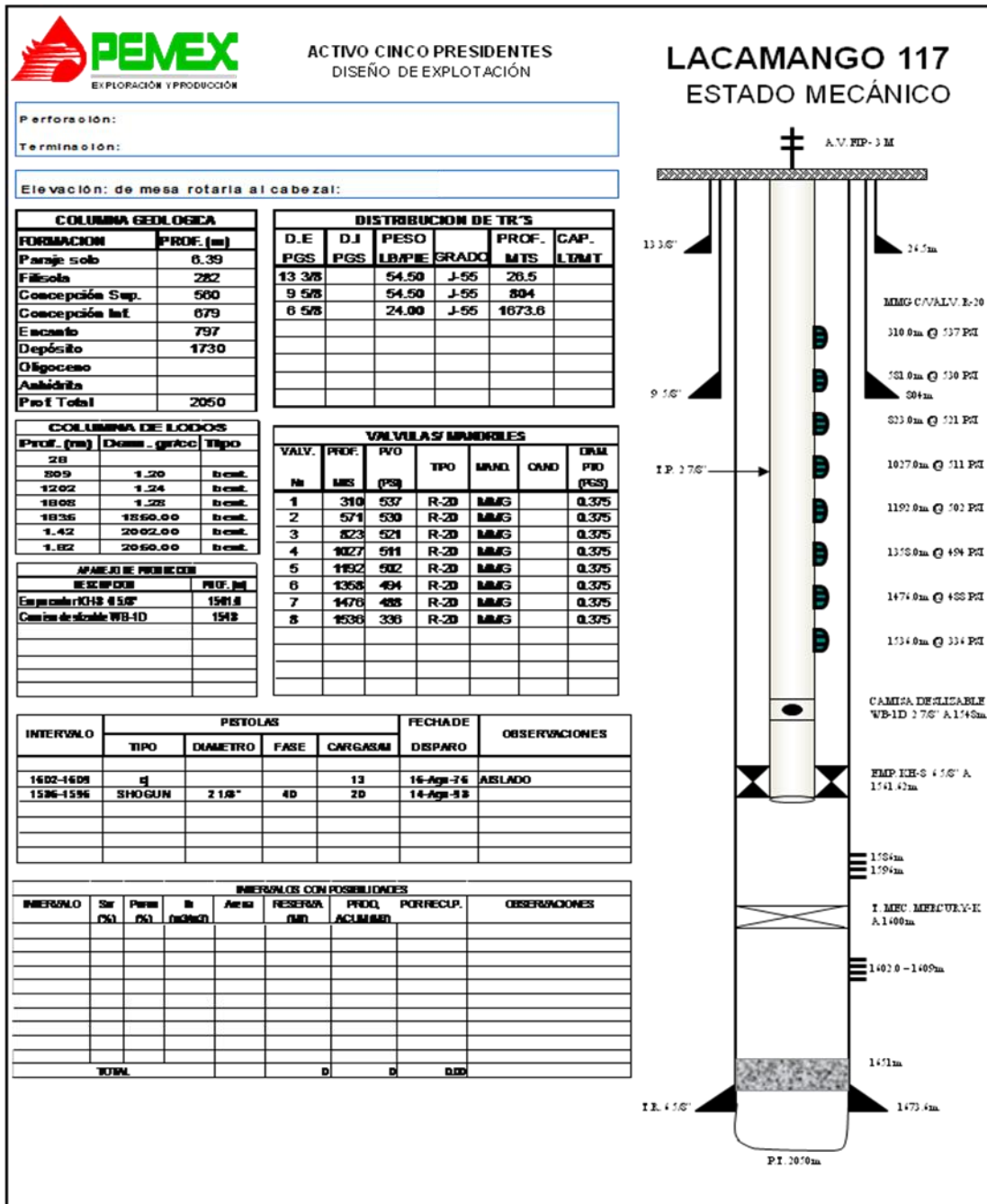
- A 6"x8" CPRS unit was installed in May, 2010 for one year performance test.
- The water line was checked for two times in-between for scale'
- The one-year performance test proved that there was no scale buildup in 12 months.

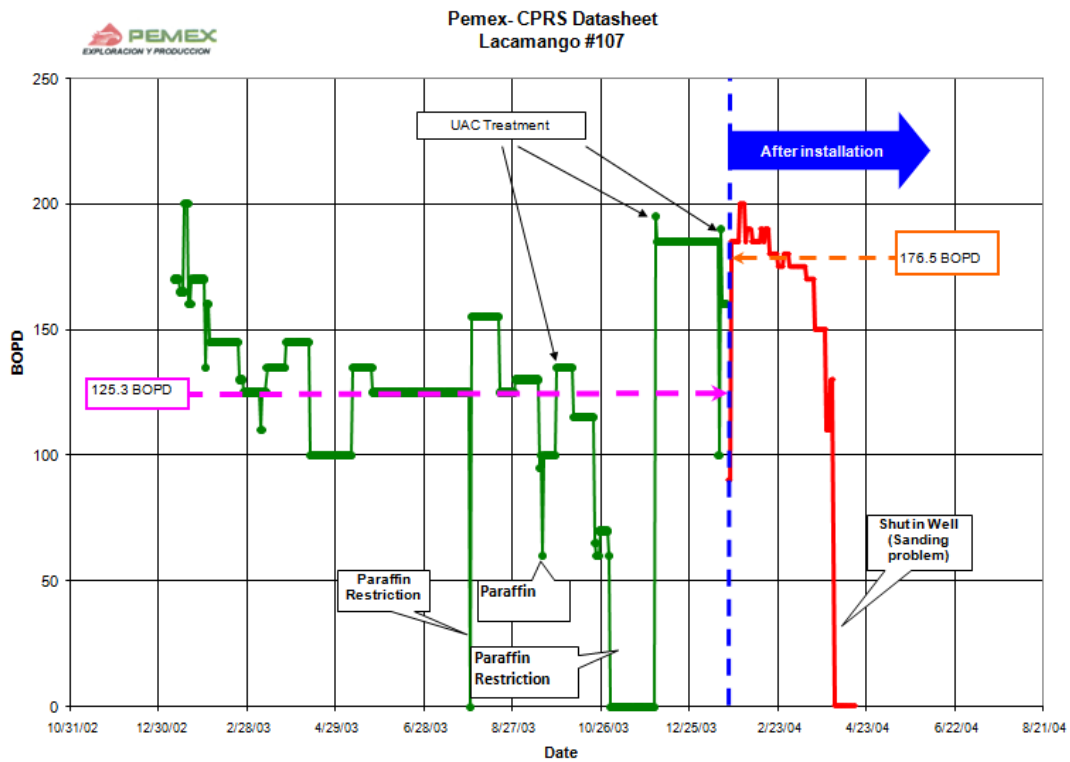
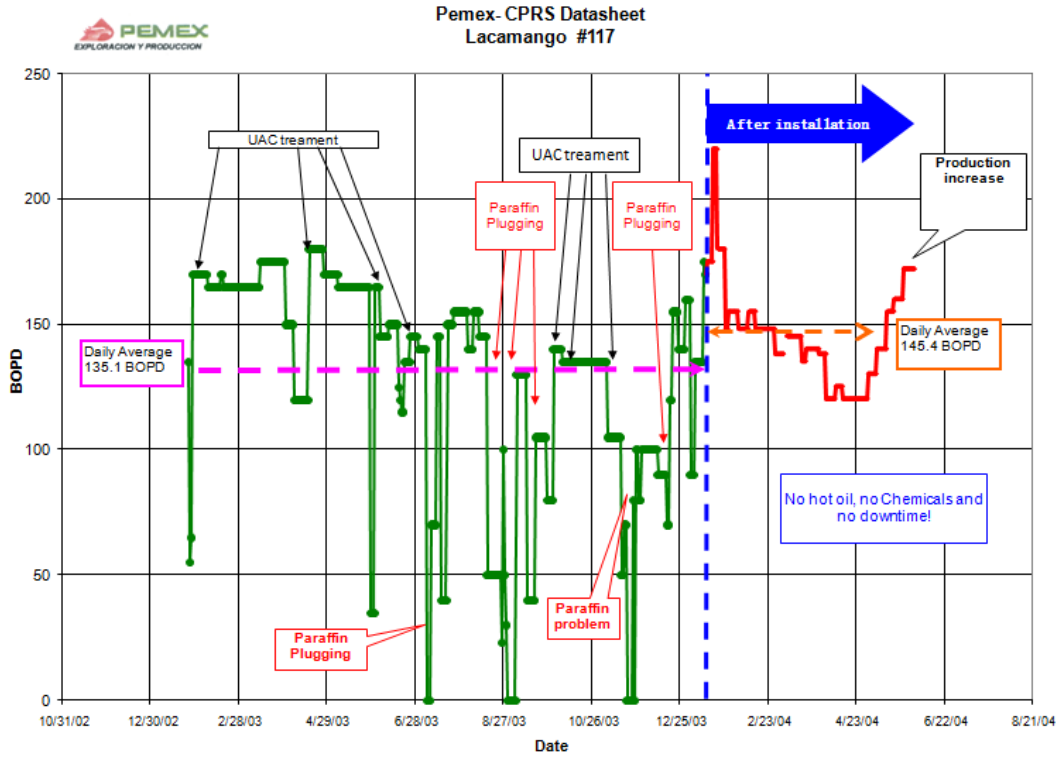
CASE NO. 20 PEMEX WELL LACAMANGO 107& 117

Location: Well Lacamango 107 & 117

Operator: PEMEX

Application: Paraffin prevention and removal





SECTION 2 INDUSTRIAL SCALE AND CORROSION SOLUTIONS

CASE NO. 1 PUMP COOLLING SYSTEM, CANGZHOU REFINERY, CHINA

Location: Pump cooling circuit, Cangzhou Refinery

CPRS unit: 2" CPRS surface unit

Application: Cooling water recirculation flowline for scale prevention and removal

Before installation:

- The pumping units were imported and very expensive pieces of equipment.
- Serious scale buildup in the cooling circuit and also inside the pump cooling chamber became an frustrated headache to the customers.

After installation:

- These units were installed in 2003, the first case of Enmax CPRS in refinery, and are stilling working properly for the customer.
- Customer never complained about the scale issues in these cooling circuits.



CASE NO. 2 HEAT EXCHANGERS, NANYANG REFINERY, CHINA

Location: Heat exchangers, Nanyang, Henan Province, China

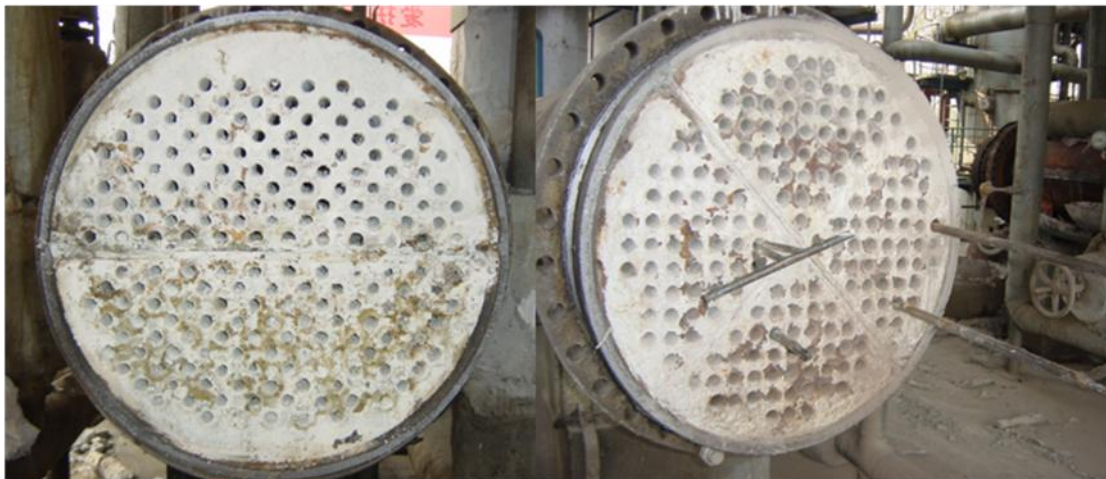
Before installation:

For years, scale buildup on the water recirculation flowline and heat exchangers has been a serious problem for Nanyang Petrochemical Plant. Although conventional methods have been taken to prevent the scale, the heat exchangers have to be mechanically cleaned every 6-8 months.

After installation:

In August, 2005, Enmax CPRS surface units were installed. On Dec., 8, 2005, 4 months after the installation, the heater exchanger was inspected, and it was found that there was not any new scale buildup and the uncleaned scale disappeared.

April, 15, 2005, heat exchangers being cleaned



Inlet

Outlet

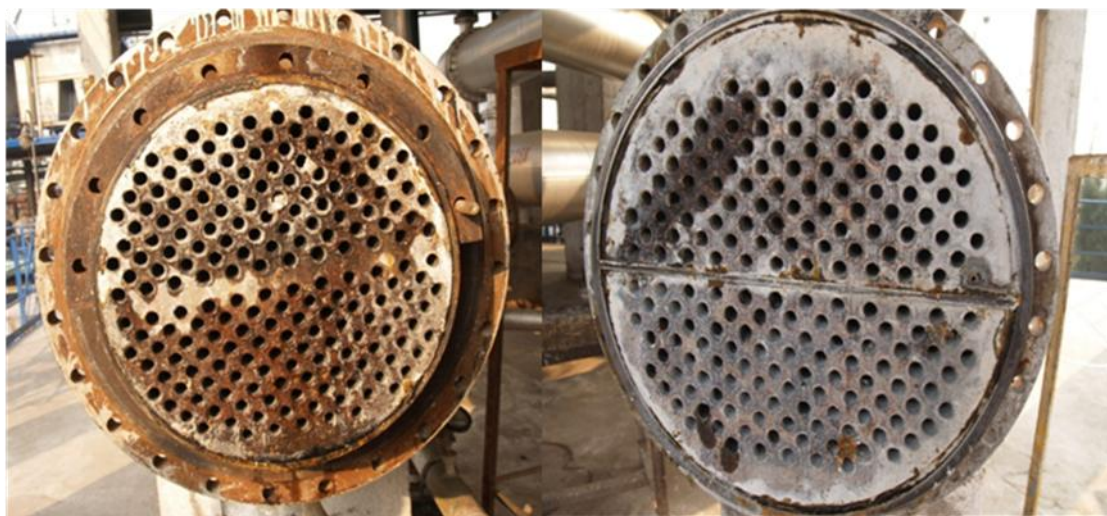
Heat exchangers after being cleaned



Inlet

Outlet

Four months after the installation



Inlet

Outlet

CASE NO. 3 SYNTHESIS AMMONIA PLANT, TAIYUAN CHEMICAL (GROUP) CO.

Location: Cooling Circuits of ammonia compressor

Application: Scale prevention and removal

**Before installation:**

- The cooling water used was untreated water from the water well.
- Serious scale problems reduced the heat exchanging efficiency.
- Periodically the cooling circuits have to be cleaned with acids or replaced with new pipes.

After installation:

- A CPRS unit was installed on June 9th, 2009.
- The CPRS unit was installed upstream feed line of six ammonia compressors.
- The cooling circuit of No. 1 compressor was plugged off by scale. Three months after the installation of CPRS, there was no new scale buildup.
- The Bajin box of No. 4 compressor used to have very consolidated scale, which needs to be drilled out with drills. After the installation of CPRS unit, the scale became very soft and can be cleaned easily.
- The discharge end of the cooling water had a layer of 1 cm hard scale deposit. Three months after the installation, the scale deposit became loose and can be pulled off with hands.
- The CPRS unit reached the test goal of scale prevention and removal, reduced the equipment downtime, and eliminated the pipe replacement.

CASE NO. 4 HEBEI XUANHUA IRON AND STEEL COMPANY

Location: Cooling system of #4 and #5 conicaster

Application: Scale prevention and removal

**Before installation:**

- High hardness of cooling water
- Serious scale buildup on recirculation manifold and water nozzles, and nozzles were often fully plugged off by scale.

After installation:

- A 8"x10" CPRS unit was installed in #4 conticaster cooling circuit on November 8th, 2009.
- A 12"x12" CPRS unit was installed in #6 Conticaster cooling circuit on December 21st, 2009.
- The inspection after 3-month installation proved that the recirculation manifold and nozzle scale issues have been solved, which assured the normal operation performance of conticasters and the quality of the steel products.

Before installtion of CPRS**After installation of CPRS**

**CASE NO. 5 ZHUZHOU SMELTER GROUP CO. LTD, HUNAN, CHINA**

Location: Cooling systems for condenser, Power Plant

Application: Scale prevention and removal

**Before installation:**

- The scale buildup in the recirculation cooling system has always been the headache problem for the production.
- Chemicals was utilized for scale inhibiting without any good result, and scale deposits and scale plugging-off still existed, which reduced the cooling efficiency and power output.
- The scale problem reduced the vacuum 15%, which directly caused a reduced power output.
- One or two time mechanical scale cleanings are required every year.

After installation:

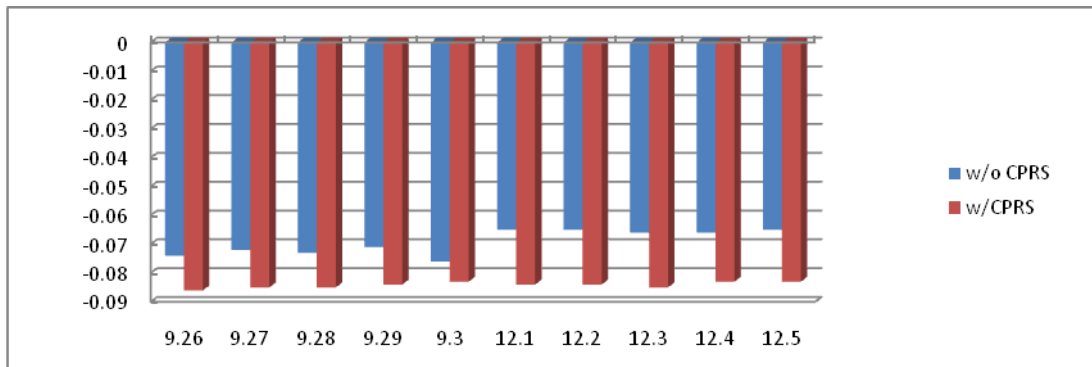
- A Enmax CPRS unit was installed on September 20th, 2010 and inspected on December 11th, 2010 for scale prevention and removal performance within 75 days.
- No chemicals added except PH control by alkali.
- Pictures were taken before the installation and 75 days after the installation for visual comparison.
- It can be seen that the vacuum was dropped 10.64% and no dropping after the installation.
- It is also noticed by the water quality monitoring that the water quality was stabilized and water hardness was controlled below 3 mmol/l, the water electric conductivity was controlled below 1000 us/cm without any obvious increase.
- The tubes had serious scales buildup and plugging-offs before the installation and there was no scale deposit after the installation.
- Before the installation, inside the inlet door, there were a lot of clay and rust scales, which were hard to clean. The inspection after the installation indicated that some of the old scales are gone and some became loose.

- It can be estimated from vacuum stabilization that the CPRS units will increase the power output by 1 million KW.

September 20. 2010, after the cleaning and before the installation



December 23. 2010, 75 days after the installation



CASE NO. 6 BAOTOU JIXIN IRON AND STEEL COMPAMY

Location: Cooling systems

Application: Scale prevention and removal



CASE NO. 7 SHANXI ZHAO GUANG POWER PLANT

Location: Cooling system for coal mills and compressors

Application: Scale prevention and removal



CASE NO. 8 SHANDONG QILU PETROCHEMICAL CHLORALKALI PLANT

Location: Cooling systems

Application: Scale prevention and removal

**Before installation:**

- The cooling system had very serious scaling problems, with a thickness of 20 mm scale built up inside of the cooling circuit.
- Chemicals and other scale inhibiting methods were tried without any success.

After installation:

- A set of Enmax CPRS was selected for performance test, and it was installed in January, 2008 and opened for inspection after three months.
- The inspection proved that there was no new scale buildup at all and the old scale was reduced to 1 mm, which is very loose and soft and can be removed with hands.

CASE NO. 9 TIANJIN PETROCHEMICAL PLANT

Tianjin Petrochemical Plant is setting up an ethylene plant with a capacity of 1 million tons per year. Enmax CPRS was approved by Sinopec Ningbo Designing Institute to be used for scale prevention. Here are the two pictures showing the installations.



CASE NO. 10 QINGDAO REFINERY

Location: Power system, Qingdao Refinery

Application: Scale prevention and removal

Description:

A 2" Enmax CPRS was installed on the power system of Qingdao Refinery in January, 2008 and it has been running successfully till today.





CASE NO. 11 VINDA PAPER (GUANGDONG) COMPANY, LTD.

Location: Water ring vacuum pump

Application: Scale prevention and removal

**Before installation:**

- The water ring vacuum pumps had serious scale problems.
- Chemical scale cleanings were required every year.
- The pump cannot be re-started smoothly after shutting down.

After installation:

- A 4"x6" CPRS unit was installed in March, 2008 at the upstream of the vacuum pump.
- The system was opened for inspection after five month.
- After the installation, the pump can be restarted smoothly every time after shutting down, which means there is no scale deposit.
- The inspection of feed line indicated that no scale was formed in five months.
- It is also noticed that the old scale thickness reduce 1 mm, which means the CPRS unit can remove the old scale.

CASE NO. 12 NANJING HUARUN THERMAL POWER PLANT

Location: Vacuum pumps

Application: Scale prevention and removal

**Before installation:**

The vacuum utilizes industrial water of high hardness as working media, thereby resulting in serious scale problems and reduced the vacuum pump efficiency.

After installation:

- A 2"x3" CPRS unit was installed in October, 2009 in the working circuit of Vacuum pump #A.
- The CPRS unit has been successful, and the scale has obviously been reduced.
- The scale, which the high pressure jetting could not remove and had to be removed with steel brushes, can be flushed away by jetting easily.
- The cleaning time reduced to less than one day from two days.
- The layer of old scale become thinner and soft, partially came off.
- Vacuum pump current reduced around 2 amps.



CASE NO. 13 PETROCHINA HUABEI PETROCHMICAL PLANT

Location: Cooling tower of air separator

Application: Scale and corrosion prevention and removal

Before installation:

- The air separator cooling tower bundles are of #10 steel, and had not been treated for corrosion resistant.
- Since the cooling tower being put into operation in 2002, the bundle had a bad corrosion problem and the bundle surface had a layer of rust scale.

After installation:

- Two months after the installation, the old rust scale came off and 1 cm of rust layer at the bottom of the cooling tower can be seen.
- The residual scale on the bundle surface became soft and loose and can be scraped off with fingers.



Case No. 14 Yimen Copper Limited Company, Yunnan Copper Group

Location: Recirculation cooling system

Application: Scale prevention and removal

Before installation:

- Scale issue in the recirculation cooling system has been a unsolvable problem for the production.
- Conventional anti-scale methods including chemicals have been tried without expected results.
- Water jackets are often scaled up and plugged off, resulting very poor cooling performance for the smoke.

After installation:

- A Enmax CPRS was installed on July 9th, 2011.
- Chemicals adding were stopped.
- Obvious scale prevention and removal results have been achieved.
- Smoke cooling has reached the expected results.



CASE NO. 15 ZHUTUN RICE NOODLE FACTORY

Location: Coal gasification unit

Application: Scale prevention and removal and water quality upgrading



Before the installation of Enmax CPRS unit, there was a serious scale and water quality problem. **After the installation**, scale problem was resolved and it is reported by the customers that better flavor of rice noodles were made.

CASE NO. 16 SHANXI BRANCH BANK OF CHINA AGRICULTURE BANK

Location: Central air conditioning systems

Application: Scale prevention and removal





SECTION 3 ENMAX CPRS PERFORMANCE CERTIFICATES FROM THE CUSTOMERS

No. 1 Production/Daqing Oilfield



No.6 Production Company/Daqing Oilfield

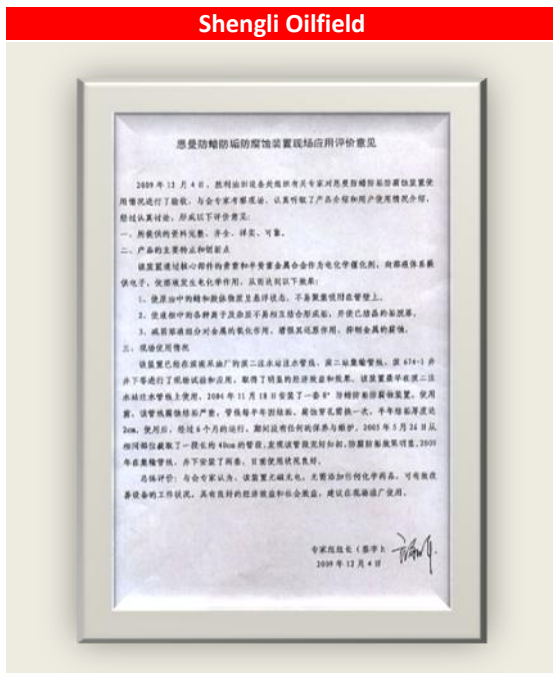


Xinjiang Kelamayi Oilfield



No.1 Production Company/Huabei Oilfield





Jidong Oilfield

关于“恩曼金属防腐垢器”在南堡油田作业区实验效果评价

2009年11月在工程技术处组织的某项工程技术交流会上介绍了恩曼金属防腐垢器，可以解决注水井堵漏防腐问题，由恩曼公司研发并由恩曼公司环境限制。防腐方式单一（仅采用化学药剂防腐），通过到中海油天津分公司实验网好，经工程技术处同意在南堡油田作业区海上导管架注井实验恩曼金属防腐垢器，目前试用2套，效果较好。

CPRS防腐垢器装置属于实用新型产品，专利号为：4789231、US04467975、US4730255。该工具的材质含有铜、锌、镍等几种不同的金属成分，这些金属可以形成一种特殊的电化学保护层，合金所包含的元素比液相中的离子活性低，该工具通过电化学的方式使流体产生极化效应，流体中的阻垢剂受其作用的影响处于悬浮状态和溶解状态，该产品具有防止垢和堵塞孔道的作用。

南堡海上导管架共有生产井29口，日增产15.11，日产量563吨，日产油508吨，含水9.7%，主要通过化学注入阻垢剂，堵漏方式单一。今年在导管架非作业区，对防垢严重的21井（N109井、N1-20X12井）在井下使用了恩曼金属防腐垢器2套，试用

Nanjing Huarun Thermal Power Co.

CPRS 防腐装置的试用效果报告

我司二期高炉煤气系统，因采用工业水作为工作介质，水质硬度高，工作中结垢比较严重，影响高炉加料效率，增加运行经济性降低。经我公司2009年技改项目关于《二期高炉煤气系统加垢器》防腐装置技术改造项目可行性报告》，2009年10月在44机C炉检修中在A高炉煤气总管路上加装试用CPRS-2“43”防腐装置一套，达到了防腐目的为正常使用效果良好，系统中水垢明显减少，炉内用水水质不达标的问题，而无需使用阻垢剂才能保持的板式冷却器中的水垢，使用高炉水冲洗就能轻松的对水垢清除，原来清理冷却器清理的时间从2天缩短到了不到1天，原来清理中的水垢也减轻了，操作人员明显减轻数量，高炉影响高炉加料效率问题已经得到了解决。

因此，该种防腐装置，在44机A高炉煤气总管路上试用确实起到了防腐、减垢及节能效果，值得在采用工业水作为工作介质的系统中推广使用。

南京华润热电有限公司技术支持部
2010-4-28

Xuanhua Iron and Steel Co.

CPRS 防腐系统的试用合格报告

公司物资供应处：
我厂连铸机二冷水管道及塔嘴在高温环境下，因水质硬度高，堵塞比较严重。2009年11月8日起在4号连铸机5-8号二冷水总管安装试用CPRS防腐系统4套，2009年12月24日起在6号连铸机5-8号二冷水总管安装试用CPRS防腐系统12套。到2010年1月1日起试用效果良好，二冷水管道塔嘴及塔嘴周围堵塞现象大幅减轻，同时由试用期间没有影响连铸机的正常生产。

随着品种产量的增加，对二冷水水质要求越来越严格，我厂急需安装防腐装置。在4号、5号连铸机1-8号二冷水总管推广使用CPRS防腐系统。

宣钢炼钢厂
2010年3月24日
王明

Zhuzhou Smelter Group Co. Ltd.

株冶集团二期冷媒器循环水系统
——恩曼CPRS防腐、除垢、防腐蚀工具使用效果报告

一、背景
宣钢CPRS防腐、除垢、防腐蚀工具向贵司订购。贵司技术部对二期冷媒器循环水系统水质进行了详细检测，发现水质硬度高，且含有大量钙、镁离子。为防止因水质硬度高导致冷媒器换热效率下降，影响生产，特向贵司订购CPRS防腐、除垢、防腐蚀工具。

二、安装
1. 水质
水质硬度高，且含有大量钙、镁离子，水质硬度高，且含有大量钙、镁离子，水质硬度高，且含有大量钙、镁离子。

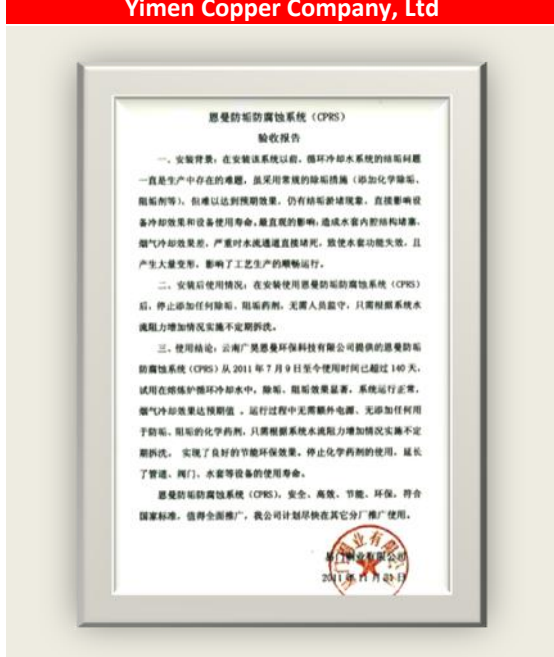
Taiyuan Chemical (Group) Co.



Vinda Paper (Guangdong) Company, Ltd.



Yimen Copper Company, Ltd



Zhengzhou Zhutun Rice Noodles Co.

