

## Corrosion protection of copper pipes in cooling systems using poly styrene solution in North oil Company/Baba Gorge

حماية الأنابيب النحاسية لأجهزة التبريد من التآكل باستخدام محلول البولي ستايرين في منطقة بابا كركر / شركة نفط الشمال

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### الخلاصة

يتضمن البحث دراسة مشكلة التآكل في الصناعة النفطية والذي يخر في جسد الاقتصاد العراقي وهو غير مسيطر عليه بصورة دقيقة ويتم اللجوء الى ميكانيكية تبديل واستيراد المعدات والادوات الاحتياطية التي تكلف البلد مبالغ مالية كبيرة . تم تحضير اربعة مستقطرات من الكازولين اضافة الى التلولين ومن ثم تحضير خمسة انواع من المذيبات وذلك بأخذ 100 مل من كل مستقطر وإذابة 30 غم من (الفلين المستخدم في حماية الاجهزة من الصدمات) متوفر ورخيص وموجود ويسبب تلوث البيئة ، بعد ذلك تم استخدام 5 مل من المزيج الناتج بمعدلات مختلفة لمزيج المستقطرات والتلولين . تم اختبار المحاليل على 15 قطعة من الانابيب النحاسية لمعدات التبريد لغرض الدراسة بعد اللحام والطلاء وتم وضعها في منطقة بابا كركر في شركة نفط الشمال وهي منطقة ذات تأثير عالي لغاز كبريتيد الهيدروجين والذي يسبب التآكل في الانابيب النحاسية لمعدات التبريد بصورة خاصة ، المزيج رقم 4 اظهر مقاومة جيدة للتآكل بعد مرور 9 اشهر من تاريخ التعرض للغاز .

الكلمات الدالة انابيب النحاس ، التآكل ، منطقة بابا كركر – شركة نفط الشمال

### Abstract

This research includes a study of the problem of corrosion in petroleum industry which decaying in the body of the Iraqi economy, and it is Non-controlled accurately and resorting to toggle mechanism and import of machinery and equipment, which cost the country large sums of money.

Four Solutions of gasoline distillates and toluene was prepared and attended the five types of solvents, by taking 100 ml of each distilled and dissolved (30) grams of material polystyrene (cork), (available, cheap and that its presence is causing pollution to the environment), then used 5 ml of a produce mixture in a different rates mixing of distillates and toluene. Solutions have been tested on fifteen models of copper pipes for cooling devices are processed for the study after welded and painted and placed at the area Baba gurgur region in the North Oil Company-Iraq as an affected area gases that cause corrosion of copper pipes in the cooling devices, the mixture of number (4) has been shown a very good resistance for corrosion after nine months from the time of exposure to the gas.

Key Words copper pipes, corrosion, polystyrene, Baba gurgur region in the North Oil Company.

## Introduction

Corrosion is the destructive attack of a material by reaction with its environment [1], and a natural potential hazard associated with oil and gas production and transportation facilities [2]. Almost any aqueous environment can promote corrosion, which occurs under numerous complex conditions in oil and gas production, processing, and pipeline systems [3]. Corrosion is one of the major problems faced by the oil and gas industry, especially in wells operating in sour conditions. Hydrogen sulfide ( $H_2S$ ) gas causes severe corrosion of equipment, in particular piping. Amine solutions are used for the removal of hydrogen sulfide ( $H_2S$ ) and/or carbon dioxide ( $CO_2$ ) gases, in order to create a low corrosion rate environment for the economical transportation of oil and gas to refineries and utilities. Corrosion due to  $H_2S$  is mainly electrochemical in nature [4].

Corrosion exists in virtually all materials, but is most often associated with metals. Metallic corrosion is a naturally occurring process whereby the surface of a metallic structure is oxidized or reduced to a corrosion product such as “rust” by chemical or electrochemical reaction with the environment. The surface of metallic structures is attacked through the migration of ions away from the surface, resulting in material loss over time. Given enough time, the material loss can result in significant reduction of area, which in turn leads to a reduction in the structural capacity of a given metallic element. When corrosion eventually destroys a sufficient amount of the structure’s strength, a failure will occur [5]. In air-conditioning applications, premature failure of copper tubing frequently occurs due to pitting corrosion after a short period in service (2-3 months) and even during post-installation leakage tests or during degreasing and stamping processes. This unusual type of localized corrosion in thin-walled tubes has been described in the bibliography as ant-nest(formicary)corrosion [6].

Corrosion can cause dangerous and expensive damage to every thin automobiles, home appliances, and drinking water systems to pipelines, bridges, and public buildings. Corrosion Control Methods are various time-proven methods for preventing and controlling corrosion depend on the specific material to be protected; environmental concerns such as soil resistivity, humidity, and exposure to saltwater or industrial environments; the type of product to be processed or transported; and many other factors. The most commonly used methods include organic and metallic protective coatings; corrosion resistant alloys, plastics, and polymers; corrosion inhibitors; and cathodic protection technique on pipelines, underground storage tanks ,and offshore structures that creates an electrochemical cell in which the surface to be protected is the cathode and corrosion reactions are mitigated [7]. Organic coatings such as Paints, coatings, and high-performance organic coatings

were developing to protect equipment from environmental damage. Of prime importance in the development of protective coatings was the petroleum industry, which produced most of the basic ingredients from which most synthetic resins were developed. The cracking of petroleum produced a multitude of unsaturated workable compounds that are important in the building of large resin polymers such as and acrylics. The solvents necessary for the solution of the resins were also derived from petroleum or natural gas. The building blocks vinyls for epoxies and modern polyurethane coatings are other derivatives produced by refining petroleum products [8]. And because of the leak which occurred in copper pipes in cooling units in North Oil Company (NOC) in Kirkuk Iraq due to emitted Hydrogen Sulphide ( $H_2S$ ) gas from the Crude Oil Treatment units, to treat the leak we must welding the leaks point and this will causes the neck points in the pipes which be more effected by the emitted gases therefore in this paper some mixtures were prepared by dissolving polystyrene material in distilled Gasoline and Toluene to coating samples of copper pipe by these solutions to isolate them from the gases.

### 1- Preparation The Gasoline Mixture

After preparing the four types of distilled gasoline which is shown in table (1), (100 ml of each distilled and toluene) have been taking and 30 grams of polystyrene have been dissolved in it to produce a new mixture which used to cover the cooper pipes by use 5 ml for the one per ratio.

**Table (1) Gasoline distilled**

Fraction number	Range of Distillation ( $^{\circ}C$ )
F 1	Initial boiling point-70
F2	60-133
F3	90-120
F4	120-160
F5	Toluene

Table (2) shows 15 samples, they depends on the variety of samples and quantities, Copper tubes were coated with a mixture to see which mixtures gave good effect To isolate them from the main cause of the interaction (Which is represented by hydrogen sulphide).

**Table(2) Show the mixture which were used in this work.**

Mixture	Fraction1	Fraction 2	Fraction 3	Fraction 4	Fraction 5
M1	1	1	–	–	2
M2	1	1	2	–	2
M3	–	1	3	2	–
M4	1	1	–	2	–
M5	2	–	3	–	3
M6	-	2	1	1	–
M7	-	3	–	2	1
M8	3	1	–	–	1
M9	2	2	–	2	–
M10	1	–	2	1	–
M11	-	–	1	3	1
M12	1	1	1	1	1
M13	1	1	2	–	2
M14	2	2	–	2	2
M15	2	2	3	–	1

## **2- Preparation The Specimen**

A - Cutting the copper pipes specimens with length (10 cm).

B - Welding the pipe specimens from two open sides to prevent the effects of emitted gases for inner surface corrosion.

C - Cleaning the welding parts of specimens by electrical smooth brush.

D - Punching the samples by putting label on them to recognize one from another.

After the above steps, the welding parts of specimens covered by the mixture (distilled gasoline, toluene and polystyrene), distributed the specimens in different locations and stations in NOC.

## **Discussion and Results**

After placing the five specimens of non-coating of copper tubes with welding parts in different areas which has different concentration of gas (CO<sub>2</sub>, SO<sub>2</sub>, CO and H<sub>2</sub>S), the maximum corrosion occurs in samples which placed in Baba Gurgur state because this place has very high concentrations of the

above gases due to the petroleum industries which are very near from this state. Then the five samples from 15th are coated by the five type of mixtures which are shown in table (2). After the (14) months of test we obtain the result which are shown in figure (1) and the very good type of mixture is mixture number (4) because The difference in weight between before and after putting the samples in concentration area in zero therefore the mixture of number (4) it has very good coating effect of prevent the corrosion which caused by emitted Hydrogen Sulphide (H<sub>2</sub>S) gas from the Crude Oil Treatment units.

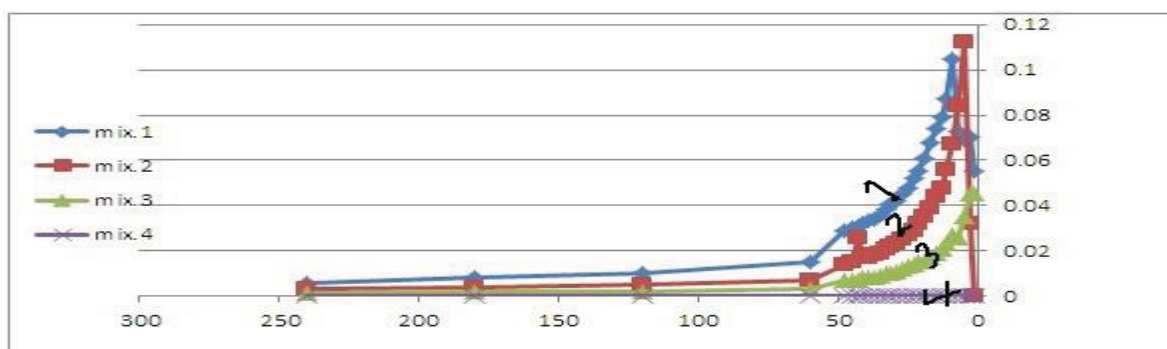


Fig. (1) Average of corrosion

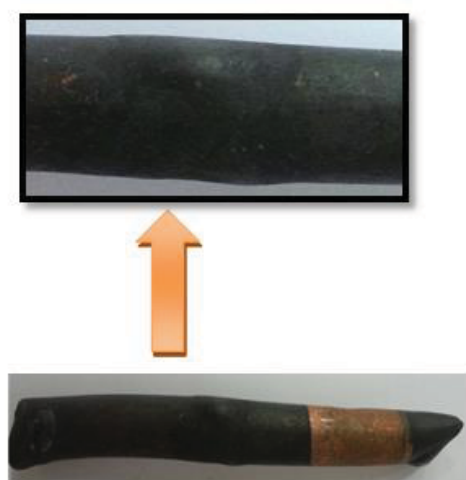


Fig. (2) Magnification of The welding area of the model number (2) encased by mix No. 2



Fig. (3) Magnification of The welding area of the model number (3) encased by mix No. 3



**Fig. (4) Magnification of The welding area of the model number (4) encased by mix No. 4**









### References

1. Handbook of corrosion engineering, PR. Roberge, McGraw-Hill, New York, 2000.
2. MBKermani and LM Smith, "CO<sub>2</sub> corrosion control in oil and gas production: design considerations", The Institute of Materials, European Federation of Corrosion Publications, London, 1997.
3. Corrosion mitigation for complex environments Champion Technologies, Champion Technologies, Houston, 2012.
4. Muhammad Shahid and Muhammad Faisal, "Effect of hydrogen sulfide gas concentration on the corrosion behavior of ASTM A-106 GRADE-A carbon steel 14% diethanol amine solution", The Arabian Journal for Science and Engineering, Vol. 34, no. 2C, pp. 179-186, December 2009.
5. Step 7 – Corrosion Guide.
6. D. M. Bastidas, I. Cayuela and J. M. Bastidas, "Ant-nest corrosion of copper tubing in air-conditioning units", *Revista de metalurgia*, septimber- octuber, vol., no. 42, pp.367-381, 2006.
7. H. Koch Gerhardus, P.H. Brongers Michiel, G. Thompson Neil, Y. Paul Virmani And J.H. Payer, "Corrosion costs and preventive strategies in the united states", NACE, CC technology, international, publication no. FHWA-RD-01-156, 1998.
8. Handbook of Corrosion Engineering, P.R.Roberge, McGraw-Hill, 1999.