The Story of

"Elro"
Reg. U.S. Patent Office

The Magic Wand

EB-105

THE PATROL VALVE COMPANY

2310 Superior Ave. Cleveland 14, Ohio

Printed in U.S.A.

The Story of "Elno"

The Magic Wand

WHAT IS RUST?

"Rust wastes more than use," says an old French proverb. Rust is the substance that brings tears to a woman's eye when she sees its presence on freshly laundered linens. Rust is the destructive force which retards man's attempt to develop for himself a higher and better standard of civilization. For centuries rust has destroyed the tools of mankind and slowly continues its waste. There is probably no greater waster to be found.

Rust is the reddish coating, essentially ferric hydroxide, formed on iron upon exposure to moist air, or water and air. It is the corrosion of iron and steel.

THE INTERNAL CORROSION OF HOT WATER STORAGE TANKS

Water, as everybody knows, has the property of dissolving, absorbing, and of being absorbed by other substances. Water readily absorbs oxygen, carbon dioxide, and many other substances. Pure water, therefore, is out of question. Substances absorbed or dissolved in water give water a taste, which may be pleasant or unpleasant, which also may be injurious to health. If the substance dissolved is oxygen, carbon dioxide, or any other acidic substance the water is known as corrosive water. If the substance is alkaline, such as the salts of calcium, or magnesium, the water is known as hard water. To form rust the water must contain some oxygen or other corrosive substance.

The chemical process is as follows: When iron is in contact with corrosive water the iron ions enter the water at the anode points on the metal, react with the water and produce ferrous hydroxide. Ferrous hydroxide is not rust, but it is converted into rust by the action of oxygen and more water. Consequently, both water and oxygen are essential to rust formation. If either is absent, rusting cannot take place. Should the water contain a slight amount of carbon dioxide or any other corrosive substance the process is more rapid. This accounts for the fact that corrosion is more aggressive in some localities than in others.

The temperature of the water is also a factor effecting the rate of corrosion. The maximum is reached at about 180 to 190 degrees Fahrenheit. The separation of the dissolved air, which adheres to the metal in the form of bubbles, seems to interfere at this point. Also, the separation of the dissolved oxygen helps to retard corrosion at this point. Other factors are the rate at which the hydrogen film upon the iron is removed, and the rate of motion of the solution adjacent to the iron. Water, when in the process of being heated, is always in motion.

On the other hand, if the water contains alkaline substances, such as caustic soda, caustic potash, or slacked lime, corrosion is retarded; because these alkaline substances form a protective film, generally known as scale, on the wall of the storage tank.

THE ELECTRO-CHEMICAL THEORY OF CORROSION

The electrochemical (or electrolytic) theory of corrosion is now generally accepted as one which explains many well established facts. Under this theory iron, like many other elements, has a definite tendency to go into solution when in contact with water or a solution. However, it can go into solution only by displacing some other element already in solution and in case of its immersion in water it displaces hydrogen. The electrochemical theory is best explained by comparison with the action in a simple primary electric cell.

In a primary electric cell two elements are used as electrodes, one having a high, and the other a low solution pressure. The solution pressure of a metal is that force that tends to drive ions of the metal into solution when it is placed, for example, in water, a water solution of salt, acid or other electrolyte. Thus, if zinc is placed in dilute sulfuric acid, zinc ions pass into solution in a positively charged condition, leaving negative charges on the metallic zinc. As they enter solution, the zinc ions replace the hydrogen ions of the sulfuric acid, forming zinc sulfate.

If the zinc is pure, or the surface has a uniform composition, the action will soon cease because of the accumulated negative charges on the metal. However, if we should now insert a piece of copper in the acid, and connect the outer ends of the metals

with a wire, the zinc will continue to dissolve. The solution pressure of copper is very low compared to zinc, the pressure of zinc being several million times as great as that of copper. Because of its low solution pressure, copper in sulfuric acid has a very low tendency to accumulate negative charges. Then the negative charges that have become concentrated on the zinc flow into the copper when the connection has been made by wire. (The direction of the flow of the negative charges, or electrons, is opposite to that which in known as the direction of flow of the current of electricity.) The positively charged hydrogen ions from the sulfuric acid migrate to the copper and become discharged atoms of hydrogen. In this way gaseous hydrogen is formed, which may be seen collecting on the copper in the form of bubbles.

In a cell of this sort, the surfaces of the metals in the solution are called the electrodes. The electrode which has the high-solution pressure and which dissolves in the electrolyte is called the anode. The low-pressure metal, at the surface of which the hydrogen ions discharge, is called the cathode.

In order that the electrochemical action, of the sort just described, may take place, it is not necessary that two separate pieces of metal be employed. It may take place between different parts of the same piece. For example, in ordinary zinc, there are great numbers of anode and cathode spots in each square inch of surface. Certain impurities occur in commercial zinc, such as lead, iron, cadmium, etc. These metals have lower solution pressures than zinc, so the zinc dissolves at those points where the metal is more nearly pure, and the hydrogen ions discharge at the relatively impure spots. Such action is known as "local action." From this standpoint, all iron and steel must be thought of as a composite structure, as though it were made of strands and patches of more or less unlike material. Iron carbide, iron sulfide, iron phosphide, etc., are more or less non-uniformly distributed or segregated. These impurities have lower solution pressure than the iron itself, hence when the surface becomes wet, the electrochemical action is set up. Thus it appears that if the iron were pure, or if the impurities were uniformly distributed, it would not corrode. Although it is probable that perfectly uniform iron or steel has never been produced, observation of the material in service shows that the more nearly this condition is approached, the less it corrodes. Moreover, observation shows another fact that lends support to the theory. The corrosion does not begin or take place evenly; some spots are more liable to attack than others, although as the corrosion proceeds, layers of different composition are exposed so that the position of the anode and cathode spots may change, and eventually the whole of the surface may become corroded. However, in any case, the iron dissolves only at those spots that are, for the time being, anode spots; and this leads to the formation of hollows which is described as pitting. Corrosion of this sort is very destructive, for the article may be entirely rusted through at some point and its value totally destroyed, as in the case of a hot water storage tank while the larger part of the tank may be but little affected.

As long as we are compelled to use various metals, each having a different solution pressure, corrosion will take place to some degree regardless of other preventive measures used. The only, and perhaps the most practical, preventive is to use a metal with a higher solution pressure than all the others used in hot water systems. Such metals are magnesium and "Elno".

"ELNO"

Elno is a magnesium alloy, and has a high electrode potential. Magnesium is one of the most abundant metals and, due to the recognition of its importance during the past war, a large capacity for its production has resulted. Although it is still a relatively expensive metal when compared to some of the more common metals such as iron, the price range today makes it a suitable material for consumer goods in those instances where large savings accrue to the consumer. It provides a solution to the mitigation and ultimate elimination of internal corrosion in hot water storage tanks.

When an Elno rod (commercially known as Elno Anodic Rod) is inserted in a hot water storage tank filled with water and electrical contact in made between the Elno rod and the tank, we have essentially a "wet cell". The Elno rod serves as an anode, the tank serves as a cathode, and the water is the electrolyte. The Elno rod will go into solution as ions. These ions travel through the water to the wall of the storage tank, and precipitate as magnesium hydroxide. The fact that Elno has a higher solution pressure than any of the other metals used in the construction of water heating systems makes it an anode to all the other metals used, and protects them. In other words it protects the galvanizing of the storage tank, the iron of the storage tank, and the brass fittings of the storage tank, as well as preventing

local action which may happen due to impurities of the metals.

THE "ELNO" ANODIC ROD

The "Elno" Anodic Rod is made in 7/8 and 1-inch diameter for domestic water heating systems, such as automatic water heaters and range boilers; for large hot water storage tanks it is available in 1 3/8 and 3-inch diameter rods. Its purpose is to prevent rust or corrosion of hot water storage tanks.

HOW IT WORKS

The "Elno" Anodic Rod works by an electro-chemical process. It sacrifices itself. That is, it forms an electric battery with the copper dip pipe and the galvanized storage tank. Because "Elno" is the element which has the greater solution factor it protects the other metals.

The rate of decomposition of "Elno" is slow. From performance data secured in accelerated tests, it has been determined by projected computation that an "Elno" Anodic Rod will serve effectively for fifteen years under mildly aggressive water conditions, ten years where the water is moderately aggressive, and five years where water is exceptionally corrosive.

ITS ADVANTAGES

The "Elno" Anodic Rod, once installed, requires no attention. There are no chemicals to add to the water. The operating process is automatic and uninterrupted.

It is positively harmless. It does not add any chemical to the water.

It is a rust preventer, not a rust remover or rust decolorizer. It does not soften hard water. It performs no chemical action of the water.

When an "Elno" Anodic Rod has been installed, water may be heated to above 150 degrees F. without causing rust or corrosion.

WHERE AND HOW CAN IT BE APPLIED

"Elno" Anodic Rods should be installed with every water heating system. They are made to fit any make of Automatic Water Heater and any type of Range Boiler. They should be used on gas-burning, oil-burning, and electric water heaters.

They are easy to install. Remove the hot water fitting and replace it with the "Elno" Anodic Rod. Every "Elno" Anodic Rod is equipped with an integral hot water fitting.

"Elno" Anodic Rod may be installed to good advantage in existing water heater systems, provided that the corrosion of the storage tank has not greatly advanced.

"ELNO" FEATURES

1. The "Elno" Anodic Rod is a **Rust-Preventer,** not a rust remover or a rust decolorizer.
2. Its basic ingredient is "Elno", a newly discovered alloy.
3. It does its work by electro-chemical action, which Prevents Corrosion of the galvanized storage tank, thus preventing the formation of rust.
4. The "Elno" Anodic Rod has a beneficial effect on soft and acid water.
5. "Elno" Anodic Rods for domestic water heating systems are made in rods of 7/8 and 1-inch diameter. Each rod is equipped with a special fitting, which also serves as the hot water outlet. The hot water line and the "Elno" Anodic Rod make one rigid assembly. For large hot water storage tanks, as used in apartment houses, commercial establishments and factories, "Elno" Anodic Rods are made in 1 3/8 and 3-inch diameter rods.
6. Installation in range boilers and automatic water heaters is simple and quickly done. Remove the hot water fitting and replace with an "Elno" Anodic Rod. For water heaters already installed "Elno" Anodic Rods are made in connected sections.
7. The "Elno" Anodic Rod requires no attention after installation. There are no chemicals to add to the water. The electro-chemical action is continuous by sacrification of the rod.
8. When an "Elno" Anodic Rod has been installed water may be heated to a temperature above 150 degrees without causing corrosion.
9. "Elno" Anodic Rods may be installed to good advantage on existing water heating systems, provided that the corrosion has not too far advanced. Sectional connected rods are available for this purpose. In any event it will appreciably lengthen the life of the storage tank.
10. "Elno" Anodic Rods can be used with the same beneficial advantage, in Gas, Electric, Oil or Coal Burning hot water supply systems.