ABSTRACT

Phosphating is the most widely used metal pretreatment process for the surface treatment and finishing of ferrous and non-ferrous metals. Due to its economy, speed of operation and ability to afford excellent corrosion resistance, wear resistance, adhesion and lubricative properties. It plays a significant role in automobile, process, and manufacturing industries. Manganese phosphate based coating decrease the coefficient of dry sliding friction considerably. The application of phosphate coating also improves the adhesive bonding of plain carbon steels. Phosphating is widely used method of reducing wear on machine elements and moving parts. Phosphate coating function as lubricants, in addition their ability to retain oil and soaps further enhance this action. Heavy manganese phosphate coatings supplemented with proper lubricants are most commonly used for wear resistance applications. The manganese phosphates widely used in automotive industry are the best to improve the ease of sliding and the reduction of associated wear of two steel surfaces sliding one against the other.

This review addresses the various wear resistance application aspects of phosphating.

Key Words: Phosphating, Manganese phosphating, Wear resistance, Tool life

INTRODUCTION

Chemical conversion coatings are adherent, insoluble and inorganic crystalline or amorphous surface films, formed as an integral part of the metal surface by means of a non-electrolytic chemical reaction between the metal surface and the solution in which they are dipped. Chemical conversion coatings are preferred because of their adherent nature and high speed of coating formation besides being economical. Chemical conversion coating processes are classified into Phosphating, chromating and oxalating according to their essential constituents, viz, phosphates, chromates and oxalates respectively.

Phosphating process is the treatment of a metal surface so as to give a reasonably hard, electrically non-conducting surface coating of insoluble phosphate which is contiguous and highly adherent to the underlying metal and is considerably more absorptive than the metal. All conventional Phosphating solutions are
dilute phosphoric acid based solutions of one or more alkali metal / heavy metal ions which essentially contain the phosphoric acid and primary phosphates of the metal ions contained in the bath. When a steel panel is introduced into the Phosphating solution, a topo chemical reaction takes place. In this reaction the ion dissolution is initiated at the micro anodes present on the substrate by the phosphoric acid present in the bath.

\[ \text{Fe} + 2\text{H}_3\text{PO}_4 \rightarrow \text{Fe} (\text{H}_2\text{PO}_4)_2 + \text{H}_2 \uparrow \]

Manganese phosphate coating is created by chemical conversion, and the main component of the film is hureaulite, \((\text{Mn}, \text{Fe})_5\text{H}_2(\text{PO}_4)_2\).

**COATING CHARACTERISTICS**

The composition of the phosphate coating is influenced by a number of factors such as the method of application, the degree of agitation of the bath, bath chemistry, the type and quality of the accelerator and the presence of other metal ions in the bath. Phosphate coating range thickness is usually quantified in terms of weight per unit area (usually as g/m² or mg/ft²) and commonly referred to as coating weight. The ratio between coating weight and coating thickness varies between 1.5 and 3.5 for the majority of the phosphate coatings used in the industries. Porosity is fairly low, in the order of 0.5 – 1.5 % of the phosphate surface. The porosity of the phosphate coating generally decreases with the increase in thickness of the phosphate coating. Porosity depends upon the type of phosphate solution, the treatment time, the iron content of the bath and the chemical composition of the coating.

**APPLICATIONS**

Phosphate coatings have been put to use on a wide variety of applications. They can be used as an excellent base for more recent methods of paint applications such as electrophoretic painting and powder coating. They have shown to have improved the corrosion resistance of steel coating subsequently with cadmium, zinc, nickel etc. They are exclusively used both in industries as well as marine based applications. Phosphating can also be used as a method of reducing wear on machine elements and moving parts. Phosphate coatings function as lubricants in addition to their ability to retain oils and soaps, which further enhances their action. Heavy manganese phosphate coatings supplemented with proper lubricants are most commonly used for wear resistance applications. The manganese phosphates widely used in

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automotive industries are the best to improve the ease of sliding and the reduction of associated wear in the simple case when two steel surfaces slide over one another.

The phosphate coatings show off no intrinsic lubricating properties but can absorb or retain a considerable amount of lubricant by virtue of their porosity. This considerably favours an easier running in at high surface pressures by forming a non-metallic barrier that separates the two metal surfaces and reduces the danger of a seizure and associated pitting. Phosphating increases the sliding distance due to scuffing as well as reduce the coefficient due to friction. The choice of phosphate coating is primarily dependent on the surface finish of the sliding counter face. Thin coatings are preferred and are suitable for smoother surfaces whereas thicker coatings are preferred for rough and uneven surfaces.

The power used in deep drawing operations set up an enormous amount of friction between the surface of the object machined and that of the die. This will decrease the speed of drawing operation as well as the service life of the tools and dies used in the drawing operations.

Application of light to medium weight non-metallic zinc phosphate coating to steel surfaces, which permit the distribution and retention of a uniform film of lubricant over the entire surface, prevent metal to metal contact and makes possible the cold forming operation as well as the extrusion process of more complicated shapes than is possible without the coating.

A combination of zinc phosphate and lubricant film prevents scratching of steel in drawing operations and greatly decreases the number of faulty products discarded due to the same.

Phosphate coating is used as an absorbent coating in laser surface hardening of steel. Although all the three major types of phosphate coatings, namely manganese, zinc and oxalate.

**CONCLUSIONS**

This class of conversion coatings is characterized by its formulation through a reaction between a solution and metal surface such that the coating is derived partly from the substrate and partly from the solution and is often produced as a precipitate or sparingly soluble salt. The benefits of manganese phosphate coatings are partly as an oil retaining coating which facilitates low friction motion and eliminates scuffing and galling thereby reducing wear and partly
as a form of lubricant which can deform slightly under pressure, thereby reducing maximum concentration. It is well known that by using a heavy manganese phosphate treatment failure due to fretting type damage is minimized especially during running in periods and so it is included in the family of wear resistant coatings.

REFERENCES


