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CHEMICAL CONVERSION COATING FOR MAGNESIUM

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This invention relates in general to a coating for magnesium and magnesium alloys, and in particular to an initial immersion coating for magnesium and magnesium alloys which facilitates and enhances subsequent priming and painting coatings for these materials.

A chemical conversion coating or an electrochemical coating is necessary as a paint base for magnesium. Current chemical conversion coatings commonly employ some means other than immersion for contacting the surface of the magnesium material. The current methods of coating involve a surface spray, electrochemical application or manual application. In addition to being costly methods of application, these chemical conversion coatings do not produce uniform results. The coatings can be marred by pitting in electrochemical applications. The coatings can be powdery or of erratic thicknesses when spraying or manual methods of application are employed. One method of immersion coating magnesium materials, although using a solid Vaseline instead of a liquid solution, is given in Patent 2,671,736 by Zoeller. This process involves a costly heating step in order to obtain an impregnated petroleum coating. From this discussion, there is evident in the prior art an absence of a liquid immersion solution to serve as a chemical conversion coating for magnesium materials.

Therefore it is an object of this invention to provide a liquid immersion solution to serve as a chemical conversion coating for magnesium and magnesium alloys.

A further object of this invention is a chemical conversion coating with uniform, powder-free surfaces on magnesium and magnesium alloys.

A further object of this invention is a less reactive and more easily controlled chemical conversion coating.

Further objects and advantages of this invention as well as its use and operation will be apparent from the following descriptions and claims.

In its most common usage, this invention is a method of promoting reaction on the surfaces of magnesium and magnesium alloys with a resultant compound formation which promotes subsequent decorative or protective coatings. This compound formation on the surfaces of magnesium materials is uniform, powder-free and pit-free, and it consists of a magnesium dichromate compound as formed by soluble dichromate ions contacting magnesium material while being catalyzed by soluble sulfate ions in an adjustable defined pH range.

This chemical conversion coating was devised specifically for rare-earth magnesium alloys. An example of of such an aloy is HK31A. Although the development of the coating solution was specifically for rare-earth magnesium alloys, the solution works adequately for all magnesium and magnesium alloy materials.

The aqueous solution range is as follows:

Sodium dichromate dihydrate, ounces/gallon	4 to 8
Sodium sulfate, ounces/gallon	0.5 to 0.8
pH	1.6 to 1.9

The proportionate remainder is water. With this solution, the immersion time is 2 to 10 minutes, the temperature is ambient or room temperature, and the mild agitation of the solution is done by filtered air.

We have found that a broad variable range of concentrations of dichromate dihydrate ions and sulfate ions

with some permissible variations in the pH range are possible in producing an effective coating solution. However the above solution has been found to operate effectively as a magnesium coating medium. Therefore the operating characteristics of the full range of constituents have not been determined as a matter of economy. The operating characteristics of the above defined range have been fully determined for our uses.

The following is a description of the procedure used to coat magnesium and magnesium alloys. After fabrication and trimming of the material, the part is degreased and allowed to dry. An alkaline cleaner, a medium-duty phosphate-silicate cleaner, follows, as improperly cleaned areas will not be coated. After cleaning, the magnesium material is pickled (i.e., corroded surface areas are removed). Rinsing in warm water (130° F. to 150° F.) prepares the magnesium material for immersion in the coating solution. Rinsing and drying the material after coating completes the application of the chemical conversion coating. Storage of the coated parts is very important as the magnesium material should be kept as clean as possible until priming and painting are complete.

Example

This example is provided as being typical and illustrative and in no manner shall serve to limit our coating process to this specific instance.

The magnesium material (HK31A, for instance) is first degreased in trichloroethylene.

A cleaning solution is employed to remove foreign substances from the surface of the magnesium material. The best cleaning solutions that we have found are medium-duty phosphate-silicate cleaners, but aluminum cleaners and heavy-duty silicate caustic cleaners also function properly.

Picking accomplishes removal of the heavily corroded areas of the magnesium material and contributes greatly to successful and reliable coatings.

The following aqueous chrome-nitrate pickle is used:

Chromic acid, ounces/gallon	40 to 50
Sodium nitrate, ounces/gallon	3.5 to 4.5
Sodium chloride (chloride ion), parts per million, maximum	10
Temperature, °F.	140
Time, minutes in solution	5 to 9

Rinsing insures proper uniform action of the coating solution and for this reason the magnesium material should be rinsed prior to contact with the coating solution. A rinse in warm water (130° F. to 150° F.) for three minutes immersion or 8 to 10 minutes in a water spray is sufficient.

The magnesium material is immersed in the following aqueous chemical conversion coating solution:

Sodium dichromate dihydrate, ounces/gallon	6
Sodium sulfate, ounce/gallon	0.65
pH	1.6 to 1.9

For effective operation the solution should be mildly agitated with filtered air. The time of immersion is 3 to 10 minutes if the solution is agitated as described above. The solution is used at ambient temperatures. When the solution becomes saturated with magnesium, usually around three ounces per gallon, it is no longer effective. The pH is adjusted to the lower limit on synthesis of the solution and maintained within the above stated range by chromic acid additions.

Following the coating, the magnesium material is rinsed as given above and allowed to dry, completing the chemical conversion coating. Storage of the conversion coated magnesium material is important as it should be

kept as clean and dry as possible until primed and painted.

We claim:

1. A coating process for magnesium and magnesium alloys in preparation for subsequent applications of coatings comprising the steps of degreasing, cleaning, pickling in a solution comprised of:

Chromic acid, ounces per gallon	40 to 50
Sodium nitrate, ounces per gallon	3.5 to 4.5
Sodium chloride (or chloride ion), parts per million, maximum	10
Water, balance	

rinsing, contacting with a coating solution of:

Sodium dichromate dihydrate	4 to 8 ounces per gallon
Sodium sulfate	0.5 to 0.8 ounce per gallon
Chromic acid	Sufficient to maintain the pH within 1.6 to 1.9
Water, balance	

and thereafter rinsing the part.

2. A coating process for magnesium and magnesium alloys in preparation for subsequent applications of coatings comprising the steps of degreasing, cleaning, pickling in a solution comprised initially of:

Chromic acid, ounces per gallon	50
Sodium nitrate, ounces per gallon	4.5
Sodium chloride (or chloride ion), parts per million, maximum	10
Water, balance	

rinsing, contacting with a coating solution comprised initially of:

Sodium dichromate dihydrate	6 ounces per gallon
Sodium sulfate	0.65 ounce per gallon
Chromic acid	Sufficient to maintain the pH within 1.6 to 1.9
Water, balance	

and thereafter rinsing the part.

References Cited by the Examiner

UNITED STATES PATENTS

1,747,776	2/1930	Jirotka	148—6.21
2,154,451	4/1939	Hull	252—79.2
2,224,528	12/1940	Sutton et al.	148—6.21 X
2,454,799	11/1948	Hart et al.	148—6.21
2,480,448	8/1949	Coates	148—6.21
2,483,510	10/1949	Stareck	148—6.21
2,796,372	6/1957	Chester	148—6.21
2,854,371	9/1958	Schjelderup	148—6.21
2,861,019	11/1959	De Long	148—6.21
3,094,489	6/1963	Barnes	252—79.2

OTHER REFERENCES

A.P.C., application of Seibel et al., Ser. No. 3,151,184, published May 11, 1943.

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