



# Development of Multi-metal Paint Coating Treatment

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## 1 Introduction

KYB motor cycle suspension (hereafter referred as KMS) manufactures the front fork (hereafter referred as FF) and the rear cushion unit (hereafter referred as RCU), the main components of a motorcycle. Especially, the superior appearance quality is required in painting process.

Two lines have been required for the painting process in KMS to satisfy the different specifications of chemical conversion coating (pretreatment) depending on the type of material. The non-chromate treatment (used to be hexavalent chromium) is required for aluminum parts while the zinc phosphate treatment for metal part.

However, there were the issue and losses associated with equipment investment and running cost for having two painting lines.

As a solution of this problem, the newly developed multi-metal paint coating treatment that can be used for both aluminum and metal parts are described in this report.

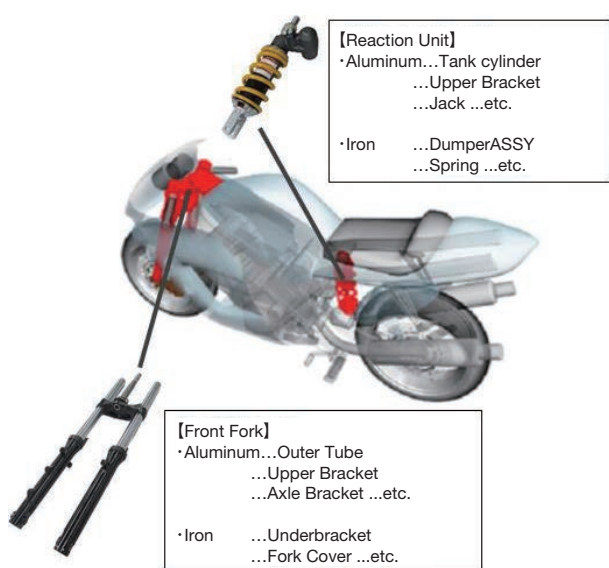


Fig. 1 Outline of Motorcycle Components and Painting Components

## 2 Function and Previous Methods of Chemical Conversion Coating (Pretreatment)

Chemical conversion coating provides the chemical reaction on the material, especially metal surface in order to create a surface with corrosion resistance and affinity character differently from its original surface. The followings are used in KMS.

### 1. Non-chromate treatment

The chromate treatment which can provide the corrosion resistance and the painting property had been widely used for the aluminum alloy material. However, The non-chromate treatment (zirconium phosphate conversion coating) was rapidly becoming the method of choice once the chrome used for this treatment was designated as restricted substance and prohibited to be contained.

The low pH (pH 2-4) and a heavily etched would be caused by using non-chromate treatment on surface. If used for iron surface, it would lead to excessive surface roughness and uneven condition.

The non-chromate solution infiltrated in the recessed and prevent a film forming on the surface, leading to rusting.

### 2. Zinc phosphate coating

This is primarily composed of phosphate ions and zinc ion. A crystalline film will be formed.

This treatment is widely used as an undercoat on iron, and improves excellent corrosion resistance and adhesion. However, if this treatment is used for aluminum, a film may not be formed due to a rise in pH (pH 4-6) and a weak etching.

## 3 Multi-metal Paint Coating Treatment Characteristics

This treatment enables a suppression of etching and a film forming on iron by lowering pH to pH 3-5 based on zirconium phosphate conversion coating suitable for aluminum substrates.

Since the etching of aluminum surface will be weakened due to a lower pH, organic acid may be added to zirconium phosphate conversion coating, and an amorphous film coating is obtained to thereby compensate the etching power on aluminum.

## 4 Our Issues to be Solved

Two lines have been required for the painting process in KMS in order to coat the different materials. Only because their pretreatments are distinguished each other, many losses are created such as more personnel and running costs to fulfill each task in 2 lines (Fig. 2).

For example, even if one line was overloaded due to variations in production volume for aluminum and iron, the tasks cannot be transferred to the other line because of only difference in coating material. In such case, over work was required everyone in one line while the other line works less straight hours.

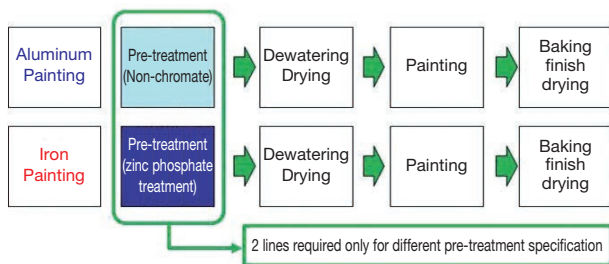


Fig. 2 KMS Painting Process Flow

Also, during the project for developing a painting process in the affiliate overseas, funding for equipment of 2 lines was very challenging, especially when the in-house production of aluminum and iron products was being promoted in most affiliates.

Therefore, KMV(KYB Manufacturing Vietnam Co., Ltd) in 2006, accompanying with a shift to in-house production for aluminum and iron, two types of pretreatment process (non-chromate treatment, zinc phosphate coating) were integrated by arranging them in series and having pretreatment system capable of switching shower depending on the material (Fig. 3).

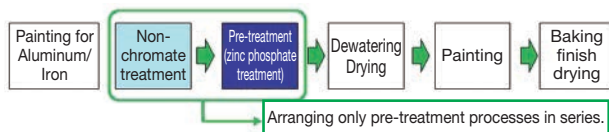


Fig. 3 KMV Painting Process Flow

This enabled the reduction in equipment investment cost and the elimination of losses for production volume of each material. However, there is the potential risk by changeover of process specifications, and unless the mist of a material is completely purged at changeover, the other materials cannot be flowed in. Therefore, the 30 min. of changeover loss occurred (at every material changeover).

Such problems were remain unsolved.

Under such conditions, the development of multi-metal paint coating treatment, which is applicable for both aluminum and iron was provided. The verification

is performed to clarify whether it is applicable to KMS products or not.

## 5 Verification with KMS Products.

### 5.1 Properties Comparison of Previous Process

Test pieces for each test were pretreated with both previous chemical conversion coating and multi-metal paint coating respectively before top painting. Then the coating performance test was performed to compare their capabilities.

#### 1. Material

Aluminum...AC2B material

Iron ...SPCC material

#### 2. Coating film performance Test Requirements

(1) Corrosion resistance test ...SST 96h→Allow 1h

(2) Adhesion test...1mm width square ×100

(3) Water resistance test ...40°C·Immersed 120h

(4) Moisture resistance test...50°C·95% or greater ×96h→Allow 2h

Note that the highest requirements in each motorcycle manufacturer shall be applied as test criteria .

#### 3. Comparison Test Result

Since the performance was equal to or higher than the previous chemical conversion coating both on aluminum and iron substrates and determined to be employed in KMS (Table 1).

Table 1 Test Result of Coating Performance Comparison

Material	Aluminum (AC2B)		Iron (SPCC)	
	Non-chromate Coating	Multi-metal Paint Coating	Zinc phosphate coating	Multi-metal Paint Coating
Film Coating				
Salt Spray Testing (SST)				
Adhesion test (square)				
Water Resistance				
Moisture Resistance				
Determination	Equal to or greater than OK		Equal to or greater than OK	

### 5.2 Toward Utilization in KMS

No abnormality found in performance test, using test pieces. However, the following concerns were found by in record by tracking the issues before the adoption of the treatment method into actual production line. The Mass production evaluation was performed.

(1) Impact from excess film

(2) Impact from Penetration into coating solution

(3) Coloration to clear painting item by coating

## 6 Obstacles for Mass Production

### 6.1 Impact From Excess Film

Excessive shower due to the stoppage of convener and downtime during production may cause an increase in the weight of chemical conversion coating, the adhesion failure between a transfer films, leading to the separation of painting.

The newly introduced multi-metal paint coating solution is capable of forming a layer that is relatively stable. Once the weight of coating film exceeds the control value 1.0, the separation of coating may be generated (Fig. 4).

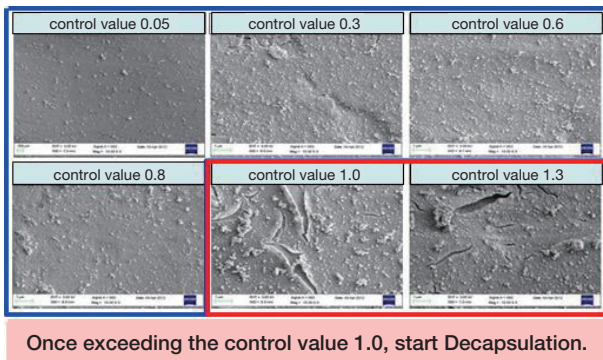


Fig. 4 Enlarged Picture of Coating

The actual work was coated by multi-metal paint coating solution, and checked for mass to the lapse of time. The saturation started after the processing time 10. The coating film was gradually increased, and then exceeded the control value (Fig. 5).

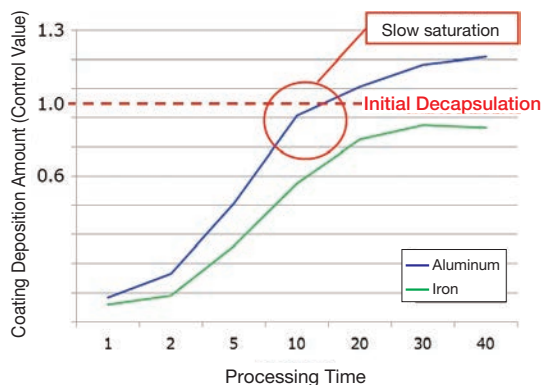


Fig. 5 Processing Time and Film Weight for Each Material

Our needs were given to a chemical maker, again in order to request the improvement that allows a saturation before reaching the control value, 1.0 that the separation of coating was initiated without impact to the processing time.

As a result, a saturation started approx. 5 minutes after the process and successfully maintain the film condition the 0.6 or under (Fig. 6). This eliminated excessive film coating.

No abnormality found during coating film performance test after the improvement.

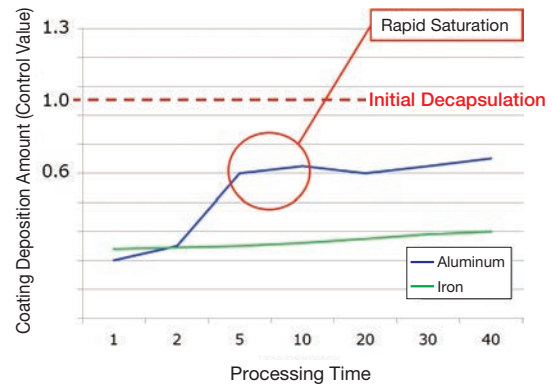


Fig. 6 Film Weight Profile after Modification

### 6.2 Impact from Penetration into coating solution

When chromate treatment was shifted to non-chromate treatment for aluminum in a past, no abnormality was found earlier during coating film performance test, however, the aluminum was penetrated into the coating solution each time it is used, adversary affecting the painting quality.

The coating film performance test was performed for each work by using an aged solution equivalent to the amount of one year use that was provided by a chemical maker.

#### 1. Manufacturer's Control Value and Penetration

##### (1) Amount of aluminum penetration

Max.=Control Value 150

Aged solution=control value 98

##### (2) Amount of iron penetration

Max.=control value 750

Aged solution=control value 470

As s result, the coating film performance test were equal and no abnormality found (Table 1).

### 6.3 Coloration to clear painting item by coating

KMS offers some aluminum outer tubes coated by a clear painting film for utilizing material's visual appeal. However, the coloration may occur depending on its components and processing times (weight of coating film). Only aluminum was verified.

When the appearance to processing time (weight of coating film) was checked, no abnormality found and the film weight is low with the official processing time 2. However, it was hazed once the film weight exceeded the control value 0.5 (Table 2).

Based on the above, it is difficult to maintain the control value 0.3 or less even with the solution that was modified for lighter weight. For clear painting film, we intend to continue our development.

Table 2 Coating processing time and Appearance after Process

		Zirconium deposition amount				Appearance Check After Coating※
		N=1	N=2	N=3	Average	
1	1	0.09	0.12	0.11	0.11	◎
2	2	0.20	0.21	0.24	0.22	◎
3	5	0.57	0.52	0.53	0.54	△
4	10	0.92	0.95	0.96	0.94	×
5	20	0.99	1.18	1.06	1.08	×
6	30	1.20	1.24	1.08	1.17	×
7	40	1.27	1.19	1.17	1.21	×

At this point, the coating solution effectively works for the product other than the transparent.

## 7 Establishment of KMSI(Plant in India)

With respect to this, upon the establishment of KMSI (KYB Motorcycle Suspension India Pvd. Ltd) in 2015, the in-house painting of aluminum part and iron part were officially decided. Then the estimate amount was approximately twice the amount of budget for equipment investment, and installation of both lines for aluminum and iron has become a great issue.

Since there was no clear painting specification in overseas, and the multi-metal paint coating, which is under development, if it is adopted, can suppress the investment cost within FS budget, KMS has decided to implement the multi-metal treatment throughout KMS group.

It has been 8 months from its launch in May 2015, and the project is turning out great with no coating-related issue found all this time.

We are still in progress for the modification in other coating that has no record. The update cycle should be determined based on the penetrating quantity measurement performed every month by a chemical maker. (Fig. 7).

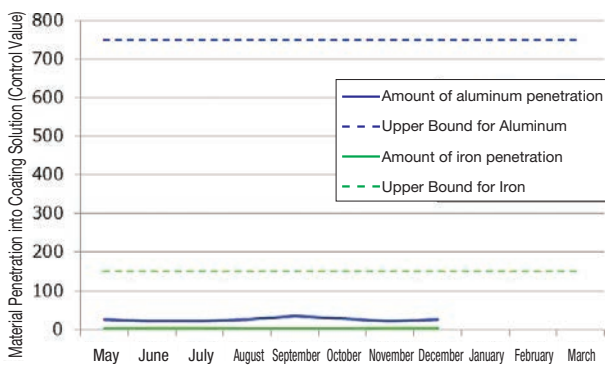


Fig. 7 Penetrating Profile for Aluminum/Iron coating solution

## 8 Future development

The newly developed multi-metal paint coating process enable the painting capability for both aluminum and iron substrates.

For the future update needed in KMS facilities due to obsolete and development of new production lines in our affiliates overseas, KMS should develop its original compact painting process line that can be directly connected with subsequent process (Fig. 8).

Also, we will continue to work on the further development in clear painting products.

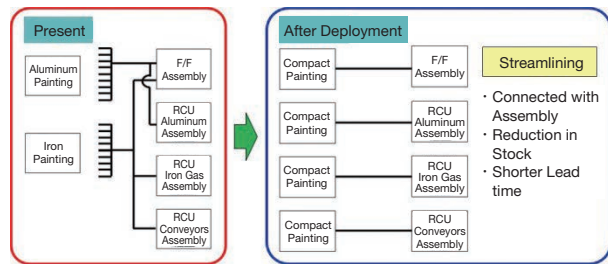


Fig. 8 Our Ideal Structure

## 9 In Closing

In this development, multiple factors, such as processing time, material, and concentration, should be taken into account. Many people including a chemical maker and persons in our painting process involved in this project.

With such cooperation, I was filled with confidence for adopting this multi-metal paint coating treatment system in KMSI although the specifications cannot be change once it is determined.

I would like to take this opportunity to express my deepest gratitude to everyone involved and provided support.

Author



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Joined the company in 1994.  
KYB Motorcycle Suspension Co.,Ltd.  
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