

# Chapter 5

## Establishment of the proposed FMEA Technique

### 5. Establishment of the proposed FMEA Technique

After conducting the FMEA, it leads to improve a lot in existing process. The recommendation actions of process that RPN exceed 100 are generated. Hereunder are the improvement points in each process.

#### 5.1 The improvement process of tinting section in the ABC Company

##### 5.1.1 Raw Material Preparation

- **White base and neutral base**

In the present process, we have never checked and controlled the quality of white base in terms of color strength. It impacts directly to color shade, and lead to many times for color adjustment. Moreover, it was found that Titanium Dioxide is the main contributor for color strength in white base. The ABC uses many sources of Titanium Dioxide grade. This leads to color deviation lot by lot. After conducting FMEA, we specific type of Titanium Dioxide grade for alkyd white base, and also implement the random checking weight of Titanium Dioxide prior to use in white base to ensure both of its quality and weight. Finally, the instruction of color strength control in alkyd white base is generated to ensure the color strength of it before releasing to tinting.

Another point that we can improve after FMEA implementation is drying time property of alkyd white base and neutral base. Long drying time of alkyd white base leads to color deviation especially in color panel preparation. It caused by quality of alkyd binder. The FMEA project generates the work instruction for

quality control of drying time of alkyd binder prior to pass through producing the white base. Moreover, all of equipment that use for checking the drying time of alkyd binder such as cube applicator, drying time recorder, ventilation system etc. are created the calibration procedure and calibration schedule to ensure the precision of equipment.

In part of storage tank of white base and neutral base, the closing system and lid of base tank are set up the preventive maintenance to prevent air react with the paint. It leads to the skinning problem. Consequently, tinted alkyd products are unacceptable in terms of quality and color deviation.

- **Tinter**

Quality of tinter in terms of color strength is the one of main point in tinted products. Prior to implement the FMEA project, color strength of tinter is board. They are  $\pm 10\%$ . It impacts to color shade and lead to color adjustment. When we start the FMEA project, it reduces to  $\pm 5\%$ , so it can reduce the variation of color shade in tinted products.

The storage of tinter

At the present, The ABC Company produced tinter for alkyd products and storage in 3 forms. They are :

1. Tinter tank 1000 liter
2. Canister size 100/200 liter
3. Pail size 20 liter

For tinter tank 1000 liter and Canister 100/200 liter, The main causes of problem consist of level of tinter, stirring power of stirrer, and circulation time of each tinter. All of them lead to color strength deviation in tinter. So the FMEA team propose the solution by set up the minimum and maximum level of each tinter, revise the stirring time for each tinter from 40 min to 20 min to make it homogenous, and no settling. Moreover, team also set up the cleaning procedure of

tinter tank to prevent the skinning problem that lead to unacceptable in terms of quality and color shade.

For pail size 20 litre, it intents to storage the less consumption of tinter. Generally, tinter made from the coloring pigment at high concentration. Hence, it can settle easily. This leads to color deviation in tinted products. FMEA team proposes the work instruction for tinter pail handling.

- **Tinting Formula**

The existing process of color formulation, the new formulations have never verified the color recipe after finish the tinting shade in the lab scale. Normally, some of tinters are hold backed to reduce uncertainty in tinting section. This leads to many times for color adjustment. The FMEA creates the new formulation sheet for new color shade by means of adding the verification section. Hence, it can ensure that formulation is more precision.

- **Raw material weighing**

Mainly improvement of this section is the tinter weighing process. At the present they are controlled by Full machine. It is the automatic dispenser. It was found that when we loading the new batch of tinter, the machine can not drop the tinter accuracy. It caused by the quality in terms of viscosity of each tinter. The FMEA team proposes the calibration sheet for Full machine after load the new batch of tinter into the tank. This recommendation leads to more accuracy of tinter weighing.

### **5.1.2 Mixing Process**

- **Tinting tank**

In the existing process, tinting tank is difficult to cleaning. It caused by the design of tank. The FMEA team proposes the modification of brush for tank cleaning. Consequently, we can clean the tinting tank easier and more cleanliness.

- **Stirring process**

The existing process the speed for alkyd tinted product does not specify. It depends on the tinting operator skill. So the FMEA team study revise the work instruction for tinting process to reduce the color adjustment.

### **5.1.3 Color panel preparation**

It was found that the processes of color panel preparation are causes of color deviation. Main problem stem from :

1. Work Instruction is not suitable. Some color shade can not follow work instruction.
2. Operator skill
3. Inaccuracy of equipment

The FMEA team proposes the recommendation actions as following :

The existing work instruction leads to color deviation of some shade especially dark shade. It was found that paint film could not cover the black and white paper, a lot bubble on paint film, thick or thin paint film etc. All of them impact to the actual color shade and lead to many times for color adjustment. The FMEA team studies and revises the work instruction to suit with any color in tinted alkyd products. Moreover, the calibration instructions of equipment are generated such as film applicator, oven etc. to ensure the precision of equipment in color panel preparation process. Finally, training session will be established to make the tinting operators understand the new procedure.

## **5.2 The example of mechanism to generate work instruction and control**

### **5.2.1 Raw Material Preparation**

- **Color strength of Alkyd white base**

The method to find out the control range of color strength for white base

1. Make the Alkyd White Base in lab scale
2. Adjust the color strength by adding the white tinter to increase color strength, and adding the Neutral base to reduce the color strength as the following 1%, 2%, 4%, 7%, and 10% respectively.
3. Measure the color strength by application on paper panel at 200 micron, keep it in drying cabinet for 20 minute, move into oven for 30 minutes, and keep it at ambient for 5 minute before measure the color strength.
4. Comparison the CIE (Color different of white base with white base standard). The CIE must be less than 0.3.

### Testing result

**Topic** : Adjust color strength of white base by adding the white tinter as following 1%, 2%, 4%, 7% and 10% respective.  
**Product Name** : Alkyd White Base

Quality	STD	Standard White Base	Add white tinter 1%
Viscosity (KU)	82-86	86	86
Density	1.10-1.15	1.14	1.14
Fineness ( $\mu$ )	15-25	15-25	15-25
Gloss (%)	>85	90.67/94.37	91.2/94.9
Drying time (Hr)	3-6	3	3
Color strength (Unrub/Rub area)		23.68/27.56 CIE = 0.60	26.27/29.53 CIE = 0.49
CIE VS STD		STD	0.35
Crypto meter ( $\mu$ )		75	75

Quality	STD	Add white tinter 2%	Add white tinter 4%
Viscosity (KU)	82-86	86-89	89
Density	1.10-1.15	1.15	1.15
Fineness ( $\mu$ )	15-25	15-25	15-25
Gloss (%)	>85	91.50/96.23	90.87/94.73
Drying time (Hr)	3-6	3	3
Color strength (Unrub/Rub area)		27.87/29.23 CIE = 0.23	29.23/30.86 CIE = 0.27
CIE VS STD		0.44	0.54
Crypto meter ( $\mu$ )		75	75

Quality	STD	Add white tinter 7%	Add white tinter 10%
Viscosity (KU)	82-86	89	89
Density	1.10-1.15	1.17	1.19
Fineness ( $\mu$ )	15-25	15-25	15-25
Gloss (%)	>85	90.7/95.5	90.73/98.50
Drying time (Hr)	3-6	3	3
Color strength (Unrub/Rub area)		32.88/34.78 CIE = 0.3	35.38/36.05 CIE = 0.13
CIE VS STD		1.13	1.71
Crypto meter ( $\mu$ )		70	65

**Table 5.1** : Color strength of Alkyd white base that adjust by white tinter

**Topic** : Adjust color strength of white base by adding the neutral base as following 1%, 2%, 4%, 7% and 10% respective.  
**Product Name** : Alkyd White Base

Quality	STD	Standard Neutral base	Add Neutral base 1%
Viscosity (KU)	82-86	89	89
Density	1.10-1.15	0.92	1.14
Fineness ( $\mu$ )	15-25	15-25	15-25
Gloss (%)	>85		92.17/96.83
Drying time (Hr)	3-6	3	3
Color strength (Unrub/Rub area)			24.75/26.74 CIE = 0.32
CIE VS STD			0.08
Crypto meter ( $\mu$ )			85

Quality	STD	Add Neutral base 2%	Add Neutral base 4%
Viscosity (KU)	82-86	86	86
Density	1.10-1.15	1.13	1.13
Fineness ( $\mu$ )	15-25	15-25	15-25
Gloss (%)	>85	91.2/97.3	92.23/98.70
Drying time (Hr)	3-6	3	3
Color strength (Unrub/Rub area)		22.59/23.46 CIE = 0.18	20.59/24.96 CIE = 0.36
CIE VS STD		0.21	0.30
Crypto meter ( $\mu$ )		85	85

Quality	STD	Add Neutral base 7%	Add Neutral base 10%
Viscosity (KU)	82-86	86	82-86
Density	1.10-1.15	1.12	1.11
Fineness ( $\mu$ )	15-25	15-25	15-25
Gloss (%)	>85	92.30/99.37	93.03/98.50
Drying time (Hr)	3-6		
Color strength (Unrub/Rub area)		18.94/19.40 CIE =0.07	17.31/17.66 CIE =0.02
CIE VS STD		0.83	1.27
Crypto meter ( $\mu$ )		90	90

**Table 5.2** : Color strength of Alkyd white base that adjust by Neutral base

## Conclusion

From the above result, The standard color strength of Alkyd white base should be controlled in range 20.0-25.0%, because they don't impact to color shade.

This leads to generate work instruction for color strength control in Alkyd white base.

- **The storage volume ( minimum and maximum level) of tinter in tinter tank**

The experimental to prove the suitable level of tinter in tinter tank.

Condition of testing

Control the color strength of tinter at level  $\pm 5\%$  before loading into tinter tank

1. Control the color strength of tinter at level  $\pm 5\%$  before loading into tinter tank.
2. Stirring time for each tank every 1 hour for 20 minute.
3. Inspect the level of tinter and recheck the color strength for every month

## Testing result

Product Code	Level of tinter (Kg)			Color strength		
	11/9/02	2/10/02	18/11/02	11/9/02	2/10/02	18/11/02
007232	250	460	520	4.25	-0.24	3.44
007233	880	140	1070	4.98	0.45	1.28
007234	310	960	180	4.94	4.39	4.89
007236	410	110	780	4.88	-1.96	2.12
007243	840	530	1070	2.6	-1.61	1.21
007279	410	670	810	-2.85	-2.15	-1.45

**Table 5.3** : Color strength of tinter in tinter tank at different level

## Conclusion

Based on the result, we can set the minimum and maximum storage for tinter as following Work Instruction Document No. 6 in Appendix III.