IMPACT OF LOW TEMPERATURE MOLD CLEANER / CONDITIONER ON MOLD PROCESS

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ABSTRACT

Molding process encapsulates the automotive sensor Electronic components using the different types of clear molding compound, this method will ensure that integrated circuits in chips will be protected against mechanical impact, extreme environment conditions and ensure that it will function to its intended purpose. Mold cleaning and conditioning is essential in molding process of Automotive sensors to ensure the good package surface condition and prevent other quality issues such as dirty package and plastic sticking to mold surface that may lead to various mold defects.

Mold cleaning process for Automotive sensors greatly affects the mold productivity due to very long set up time both prior and after mold cleaning and further intensified by the short period of mold cleaning frequency.

As part of continuous improvement, Process Engineering initiated the actions and conducted the study to identify all factors contributing to very long mold cleaning activity and the short mold cleaning interval resulting to low mold productivity. Have considered all factors related to materials, environment conditions, machine set up and parameters and other potential factors that contributing to the issue.

After identifying of all potential rootcauses, Engineering group headed the searching of material external provider and collaborate based on our requirements. Detailed information will be discussed on the latter part of this presentation.

1. 0 INTRODUCTION

Fastech has started the processing of automotive sensor products using the clear molding compound. Clear molding compound is one of the variety of thermo set epoxy molding compound use for molding encapsulation of various semiconductor device, specifically the optical semi-conductor products.

Molding process of automotive sensors are using the distinctive mold parameters where the mold temperature set up is ranging from 150°C to 160°C, this is considered as one of the lowest mold temperature set up in semi-conductor assembly, a wide gap mold temperature set up will be noted comparing the black packages having the standard range of 175°C to 185°C.

Process Engineering have qualified the common mold cleaning and conditioning materials use for clear and black packages. Due to mold cleaning and conditioning relevant material properties and characteristics, it gave the negative impact for clear packages mold productivity and material usage cost where the mold cleaning is required every 150 mold shots due to early occurrence of dirty package rejections under steady state operating conditions.

Changing of mold machine set up every mold cleaning for clear packages are required by converting the mold temperature from standard set up of 155°C to 175°C just to achieve the mold cleaning effectiveness of rubber cleaner material. The mold cleaning process condition for clear packages gave the productivity loss in terms of mold cleaning downtime and material usage cost.

To cope with every mold cleaning increasing operating costs concerning the materials, man power, power consumptions, and the impact on mold productivity, Process Engineering have driven to formulate solutions that aim to increase the mold productivity by increasing the required mold shots between mold cleaning interval and decrease the mold cleaning time, then simultaneously decrease the cleaning material usage cost. These will be the focus of our discussion.

1.1) Problem description:

High mold cleaning operating cost related to the following:

1) Short mold cleaning interval

2) High material usage rate

3) Long mold cleaning downtime.

Current Mold Cleaning Process Flow

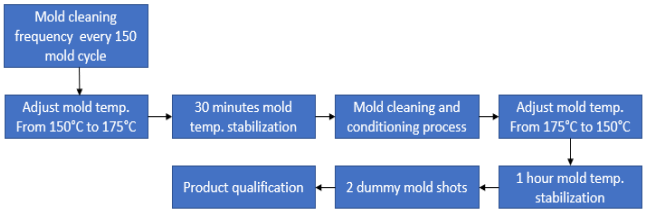


Table 1-1 Material cost (Mold cleaner)

MQB

PROCESS	VOLUME	CLEANING FREQUENCY	UNITS PER SHOTS	UNITS PER CLEANING	NO. OF CLEANING	USAGE PER CLEAN	TOTAL CONSUMPTION (KG)	COST PER KG	TOTAL COST
CURRENT (old rubber cleaner)	2,300,000	150	96	14400	159.72	1.30	207.64	$ 13.80	$ 2,865.42
CURRENT (old rubber conditioner)	2,300,000	150	96	14400	159.72	0.61	97.43	$ 13.80	$ 1,344.54

TOTAL COST PER YEAR : $ 4,210.0

B8

PROCESS	VOLUME	CLEANING FREQUENCY	UNITS PER SHOTS	UNITS PER CLEANING	NO. OF CLEANING	USAGE PER CLEAN	TOTAL CONSUMPTION (KG)	COST PER KG	TOTAL COST
CURRENT (old rubber cleaner)	602,441	200	96	19200	31.38	1.66	51.96	$ 13.80	$ 717.06
CURRENT (old rubber conditioner)	602,441	200	96	19200	31.38	0.83	25.98	$ 13.80	$ 358.53

TOTAL COST PER YEAR : $ 1,076

F1 / F2

PROCESS	VOLUME	CLEANING FREQUENCY	UNITS PER SHOTS	UNITS PER CLEANING	NO. OF CLEANING	USAGE PER CLEAN	TOTAL CONSUMPTION	COST PER KG	TOTAL COST
CURRENT (old rubber cleaner)	972,106	200	50	10000	97.21	0.92	89.43	$ 13.80	$ 1,234.19
CURRENT (old rubber cleaner)	972,106	200	50	10000	97.21	0.46	44.72	$ 13.80	$ 617.09

TOTAL COST PER YEAR : $ 1,851

Total material cost per year = $7,136.82

Table 1-2 Process cost (Mold cleaner)

MQB

PROCESS	VOLUME	CLEANING FREQUENCY	UNITS PER SHOTS	UNITS PER CLEANING	NO. OF CLEANING	CLEANING TIME PER CLEAN	TOTAL CLEANING TIME	DL COST	UTILITY COST	TOTAL COST
CURRENT (old rubber cleaner)	2,300,000	150	96	14400	159.72	2.00	319.44	$ 1.30	$ 5.71	$ 2,239.31

TOTAL COST PER YEAR : $ 2,239

B8

PROCESS	VOLUME	CLEANING FREQUENCY	UNITS PER SHOTS	UNITS PER CLEANING	NO. OF CLEANING	CLEANING TIME PER CLEAN	TOTAL CLEANING TIME	DL COST	UTILITY COST	TOTAL COST
CURRENT (old rubber cleaner)	602,441	200	96	19200	31.38	2.00	62.75	$ 1.30	$ 5.71	$ 439.91

TOTAL COST PER YEAR : $ 440

B8

PROCESS	VOLUME	CLEANING FREQUENCY	UNITS PER SHOTS	UNITS PER CLEANING	NO. OF CLEANING	CLEANING TIME PER CLEAN	TOTAL CLEANING TIME	DL COST	UTILITY COST	TOTAL COST
CURRENT (old rubber cleaner)	602,441	200	96	19200	31.38	2.00	62.75	$ 1.30	$ 5.71	$ 439.91

TOTAL COST PER YEAR : $ 440

Total process cost per year = $4,402.11

Total Cost : $7,136.82 + $4,402.11 = $11,178.93

Data showed the process cost and mold cleaning material cost for packages that will serve as reference. Further improvement will be realized by implementing changes that could give best impact on mold process cost and mold cleaning material cost.

2. 0 REVIEW OF RELATED WORK

Not Applicable.

3.0 METHODOLOGY

3.1.1 Use fish bone diagram for rootcause analysis.

3.1.2 Collaborate with external material provider.

3.1.3 Use the PDCA to execute the project.

3.1.4 Evaluate the mold cleaner and conditioner

3.1.5 Qualify and gather all needed data

3.1.6 Perform the final qualification and documentations

3.1.7 Utilize by production

3.1 FAILURE ANALYSIS:

Fishbone Analysis

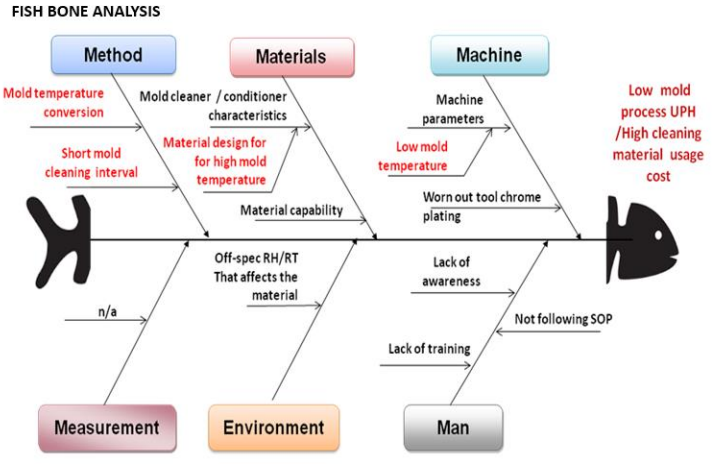


Figure 3-1 Fish bone diagram to identify and validate the potential factors.

Have identified four (4) factors related to method, materials and machine.

Under Method:
→Mold temperature conversion and short mold cleaning interval

Under Materials:
→Material design for high mold temperature
Under Machine:
→Low mold temperature

3.1.1 Validation

1) Mold temperature conversion from 155°C to 175°C is documented on mold process specification.
2) Short mold cleaning interval of 150 mold shots is documented on mold process specification.
3) Material design for high mold temperature with minimum requirements of 165°C based on material TDS.
4) Low mold temperature set up based on control plan as per clear EMC requirements.

3.2 EXPERIMENTAL SECTION

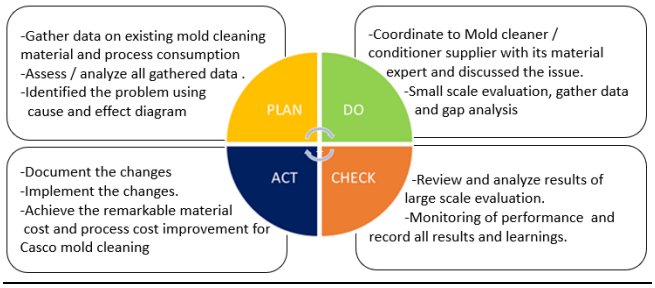
3.2.1 Objective

-To evaluate the low temperature rubber mold cleaner and conditioner materials.
- Increase the mold productivity, reduce the process cost and mold cleaning material cost.

3.2.2 Equipment and Materials

-Low Temp (new) rubber compression cleaning material
-Low Temp (new) rubber compression conditioner material
-Liquid wax in bucket container
-Mold press
-Mold tool
-CDA
-Semi-auto wax sprayer system

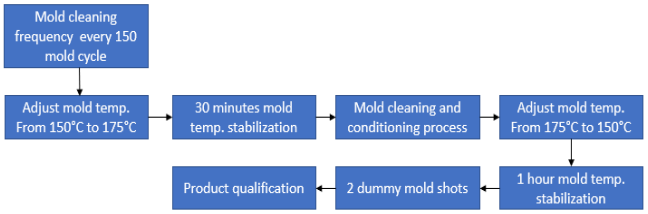
3.3 USE PDCA TO EXECUTE THE PROJECT



4.0 RESULTS AND DISCUSSION

4.1 Process Improvement:

- Process Flow reduction from 8 steps to 4 steps;
From:



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4.2 Material Cost comparison (Old and new mold cleaner and conditioner)

Material Cost savings projected for the period of 1 year.

Table 4-1 Material cost (Mold cleaner)

MQB

PROCESS	VOLUME	CLEANING FREQUENCY	UNITS PER SHOTS	UNITS PER CLEANING	NO. OF CLEANING	USAGE PER CLEAN	TOTAL CONSUMPTION (KG)	COST PER KG	TOTAL COST
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CURRENT (old rubber conditioner)	2,300,000	150	96	14400	159.72	0.61	97.43	$ 13.80	$ 1,344.54
PROPOSED (new rubber cleaner)	2,300,000	300	96	28800	79.86	1.40	111.81	$ 14.80	$ 1,654.72
PROPOSED (new rubber conditioner)	2,300,000	300	96	28800	79.86	0.74	59.10	$ 14.80	$ 874.64

TOTAL SAVINGS PER YEAR : $ 1,680.6

B8

PROCESS	VOLUME	CLEANING FREQUENCY	UNITS PER SHOTS	UNITS PER CLEANING	NO. OF CLEANING	USAGE PER CLEAN	TOTAL CONSUMPTION (KG)	COST PER KG	TOTAL COST
CURRENT (old rubber cleaner)	602,441	200	96	19200	31.38	1.66	51.96	$ 13.80	$ 717.06
CURRENT (old rubber conditioner)	602,441	200	96	19200	31.38	0.83	25.98	$ 13.80	$ 358.53
PROPOSED (new rubber cleaner)	602,441	300	96	28800	20.92	1.78	37.31	$ 14.80	$ 552.11
PROPOSED (new rubber conditioner)	602,441	300	96	28800	20.92	1.00	21.01	$ 14.80	$ 310.97

TOTAL SAVINGS PER YEAR : $ 212.5

F1 / F2

PROCESS	VOLUME	CLEANING FREQUENCY	UNITS PER SHOTS	UNITS PER CLEANING	NO. OF CLEANING	USAGE PER CLEAN	TOTAL CONSUMPTION (KG)	COST PER KG	TOTAL COST
CURRENT (old rubber cleaner)	972,106	200	50	10000	97.21	0.92	89.43	$ 13.80	$ 1,234.19
CURRENT (old rubber conditoner)	972,106	200	50	10000	97.21	0.46	44.72	$ 13.80	$ 617.09
PROPOSED (new rubber cleaner)	972,106	300	50	15000	64.81	0.99	64.21	$ 14.80	$ 950.29
PROPOSED (new rubber cleaner)	972,106	300	50	15000	64.81	0.56	36.16	$ 14.80	$ 535.23

TOTAL SAVINGS PER YEAR : $ 365.8

Total material cost savings per year = $2,258.85

4.2 Process Cost comparison (Old and new mold cleaner and conditioner)

Material Cost savings projected for the period of 1 year

Table 4-2 Process Cost (Mold cleaner

MQB

PROCESS	VOLUME	CLEANING FREQUENCY	UNITS PER SHOTS	UNITS PER CLEANING	NO. OF CLEANING	CLEANING TIME PER CLEAN	TOTAL CLEANING TIME	DL COST	UTILITY COST	TOTAL COST
CURRENT (old rubber cleaner)	2,300,000	150	96	14400	159.72	2.00	319.44	$ 1.30	$ 5.71	$ 2,239.31
PROPOSED (new rubber cleaner)	2,300,000	300	96	28800	79.86	1.30	103.82	$ 1.30	$ 5.71	$ 727.77

REDUCE 42 MINS FROM ORIGINAL CLEANING TIME

TOTAL SAVINGS PER YEAR : $ 1,512

B8

PROCESS	VOLUME	CLEANING FREQUENCY	UNITS PER SHOTS	UNITS PER CLEANING	NO. OF CLEANING	CLEANING TIME PER CLEAN	TOTAL CLEANING TIME	DL COST	UTILITY COST	TOTAL COST
CURRENT (old rubber cleaner)	602,441	200	96	19200	31.38	2.00	62.75	$ 1.30	$ 5.71	$ 439.91
PROPOSED (new rubber cleaner)	602,441	300	96	28800	20.92	1.30	27.19	$ 1.30	$ 5.71	$ 190.63

REDUCE 42 MINS FROM ORIGINAL CLEANING TIME

TOTAL SAVINGS PER YEAR : $ 249

F1 / F2

PROCESS	VOLUME	CLEANING FREQUENCY	UNITS PER SHOTS	UNITS PER CLEANING	NO. OF CLEANING	CLEANING TIME PER CLEAN	TOTAL CLEANING TIME	DL COST	UTILITY COST	TOTAL COST
CURRENT (old rubber cleaner)	972,106	200	50	10000	97.21	2.00	194.42	$ 1.30	$ 5.71	$ 1,362.89
PROPOSED (new rubber cleaner)	972,106	300	50	15000	64.81	1.30	84.25	$ 1.30	$ 5.71	$ 590.59

REDUCE 42 MINS FROM ORIGINAL CLEANING TIME

TOTAL SAVINGS PER YEAR : $ 772

Total Process cost savings per year = $2,533.12

Total Cost Savings : $2,258.85 + $2,533.12. = $4,791.97

4.3 Cost savings Summary

Cost savings projected for the period on 1 year both Mold cleaning and conditioning material cost and process cost.

Table 4.1 Cost savings matrix

SUMMARY COST

CLEANING PROCESS

PROCESS	PROCESS COST	MATERIALS COST	TOTAL COST
CURRENT (old rubber cleaner)	$ 4,042.11	$ 7,136.82	$ 11,178.93
PROPOSED (new rubber cleaner)	$ 1,508.99	$ 4,877.97	$ 6,386.96

TOTAL SAVINGS : $ 4,791.97

1) Current process and material cost = $ 11,178.93
2) Proposed process and material cost = $ 6,386.96

TOTAL COST SAVINGS PER YEAR OF $ 4,791.97

4.4 Project investment and cost data

N/A

5.0 CONCLUSION

The project effectively attained its objectives:
-Decreased mold cleaning and conditioning material cost by **31.65%** (from $7,136.82 to $4,877.97).

-Decreased the process cost by **63%** (from $4,042.11 to $1,508.99).

- Significantly reduce the yearly mold cleaning cost by **42.88%** (from $11,178.93 to $6,386.96) or a yearly cost savings of **$4,791.97.**

-Resolved downtime concerning mold tool cleaning for Automotive sensor packages.

6.0 RECOMMENDATIONS

Recommended to consider to negotiate with supplier to furthere decrease of material cost considering the fan-out of usage to black packages.

7.0 ACKNOWLEDGMENT

The author acknowledges the contribution of mold cleaner and conditioner supplier.
ENGINEERS for sharing their knowledge and expertise to determine the mold cleaning materials compatible to molding process using low mold temperature.
- Wally Agcambert and Rica Medrano for their support and motivation of this project.
- Fastech IE, Mr. Alexis de Torres on his support and contribution for the completion of this project.

8.0 REFERENCES

N/A

9.0 ABOUT THE AUTHORS

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He joined Fastech since February 01, 2013

10.0 APPENDIX

N/A