

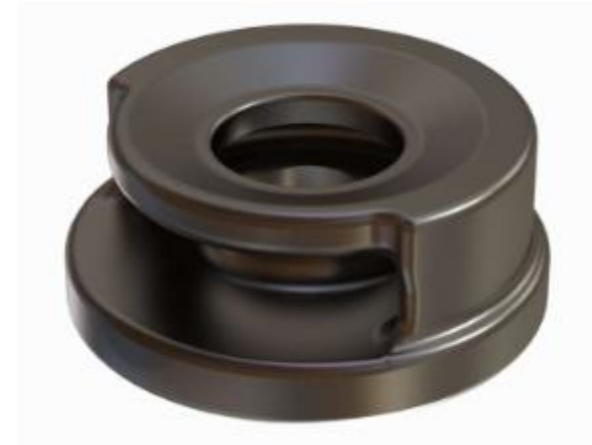


Intercoat Drying and Shell Characteristics for Investment casting Industry

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TUESDAY, AUGUST 15, 2023
(9.00 a.m to 9:30 a.m)

- **Presentation outline:**
 - **Statement of Purpose / Problem Statement**
 - **Experimental Procedure**
 - **Data Generation**
 - **Results and Trends**
 - **Observations & Conclusions**
 - **Summary and Future Work**
 - **Acknowledgments**



Statement of Purpose / Problem Statement



We are facing in-house rejection percentage 30% initially for Seal plate casting which is using in oil flow line in engine of 4 wheeler. The oil passage area is as cast and required the flatness is +/- 0.30mm. Due to insufficient dryness time of the shell, we are facing bulge, extra metal, inclusions and etc., So that we unable to meet the quality and productivity. Here, we procure the 3 different type of imported slurry and stucco material. We freeze the parameter set the Slurry/stucco mixing ratio and its related parameter. Based on the trials, we eliminate the bulge defects and reduce the other rejections. But, till the study is going to eliminate the remaining rejections.

Methodology



All possible 'X's

Problem

Bulge, extra metal, unfill and other defects on seal plate casting

Observation

Monitoring the shelling process through Gemba visit, Check sheet, Pareto Analysis

Analysis

Data collection, Pareto, Fishbone diagram, Scatter diagram, Concentration chart

Action

Brainstorming, Solution development, Risk & Cost benefit analysis, Pilot implementation

Check

Check sheet, Histogram, Pareto, Run charts, Full scale implementation

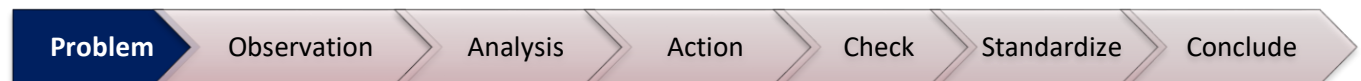
Standardize

Process Card, Control Plan and SOP

Few 'X's

Conclude

Pareto, Matrix diagram, Finance vetting, Way forward Acknowledgements



Experimental Procedure



- Re visit the gate area and injection point on the mold
- Based on the data collection, identify the top 3 problems using pareto analysis
- Based on Pareto analysis, we identify the root cause by using Cause and effect analysis tool
- Based on the results, we identify the root cause due to change the method and take the second trial (sequence of slurry coat reduce the shell dryness time).
- After trial-2, the bulge and other rejection percentage is reduced from 30% to 25%
- Again we analyze by using pareto and find out the root cause due to material characteristics and its mix-up ratio
- We procure the 3 types of imported material from USA and conducted the trial-3
- Out of 3 trials, one trial result found good. In this trial, we eliminate the bulge problem in the seal plate part. Also, reduce the other problems
- But, till the another trials study is going to eliminate the remaining rejections

Data Generation – Initial Study

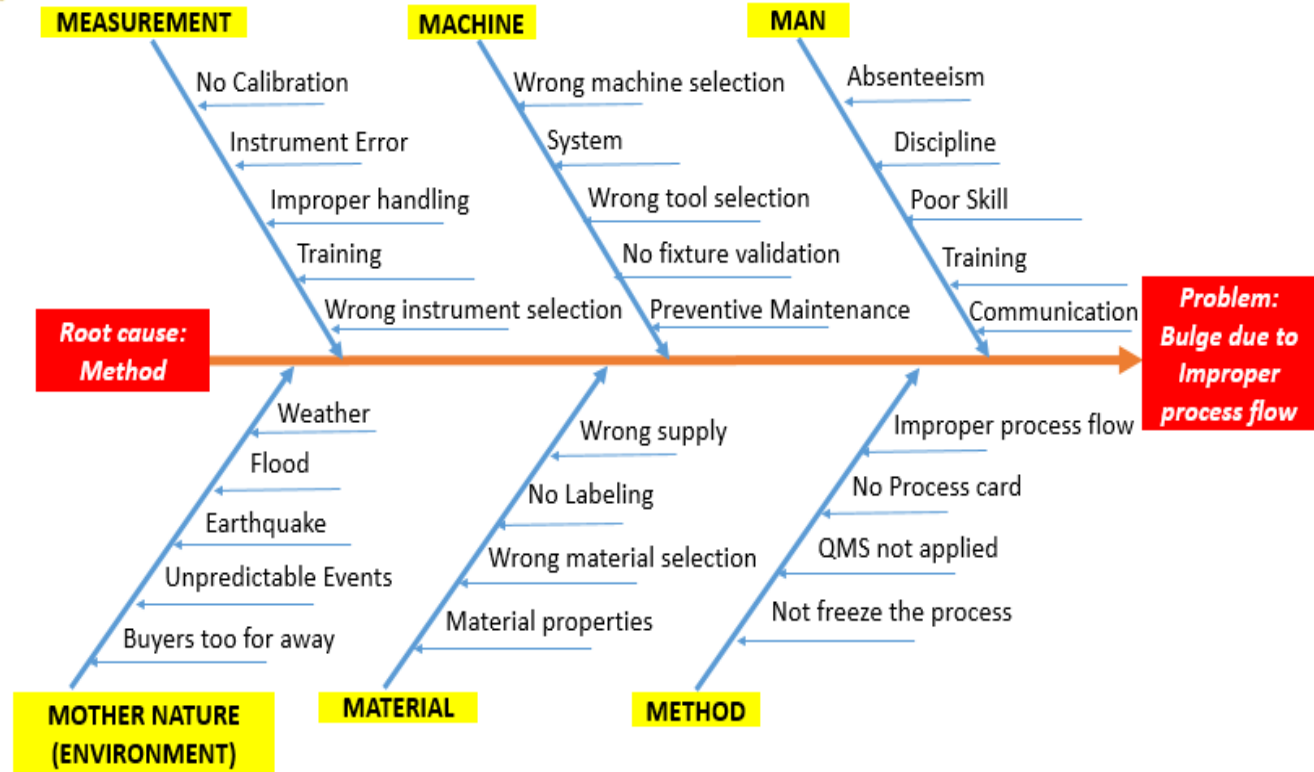
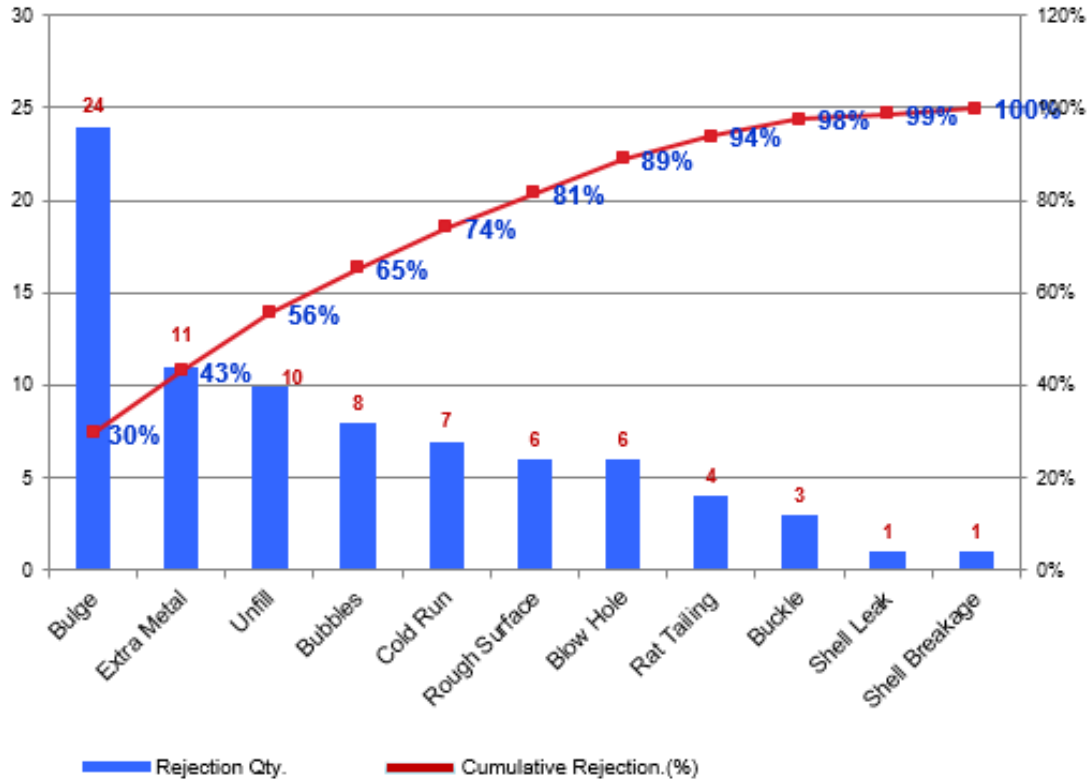


TRIAL - 1	SEQUENCE OF SLURRY CONSUMPTION					
	PRIMARY COATING SLURRY	CONSUMPTION	SECONDARY COATING SLURRY	CONSUPTION	BACK-UP COATING SLURRY	CONSUPTION
	Zircasil	75 Kgs.	Siluminate	60 Kgs.	Clay-200	60 Kgs.
	Colloidal Silica	18 Kgs.	Colloidal Silica	30 Kgs.	Colloidal Silica	30 Kgs.
	Wetting Agent	0.150 MI	Wetting Agent	0.150 MI	Wetting Agent	0.150 MI
	Anti foaming agent	0.150 MI	Anti Foaming Agent	0.150 MI	Anti Foaming Agent	0.150 MI
Demineralised Water	2 Litrs.	-	-	-	-	

TRIAL - 1	#	SLURRY COATING	STUCCO	DRYING TIME (in Hrs.)	VISCOSITY (B4 Cup in Sec.)
	1	Primary Coating	Zircon Sand	22-24	90-120
	2	Secondary Coating	AS 50/80	22-24	20-30
	3	Secondary Coating Seal Dip	-	22-24	23-25
	4	Secondary Coating	AS 50/80	22-24	20-30
	5	Secondary Coating - Seal Dip	-	22-24	23-25
	6	Secondary Coating	AS 50/80	22-24	20-30
	7	Back-up Coating	AS 30/80	22-24	20-30
	8	Back-up Coating	AS 30/80	22-24	20-30
	9	Back-up Coating	AS 16/30	08-12	20-30
	10	Back-up Coating - Seal Dip	-	08-12	23-25
Total Hours				216	

- For all the trails taken by 10 trees. Each tress contains 30 Nos. The part weight is 85grams. So, 300 Nos. consider for trial quantity
- Initial trial conducted by using existing material
- There is no changes for the material, mix-up ratio, coating sequence, drying time and its viscosity
- 10 coatings are made and their total drying time is 216 hours.

Results for Initial Study



For Initial study, the results found more rejection. Especially bulge is major contribution. Based on pareto study and cause-effect diagram, we found the root cause for method and changed the coating sequences. So, the trial-1 conducted and the results shows in next page.

Data Generation - Trial - 1

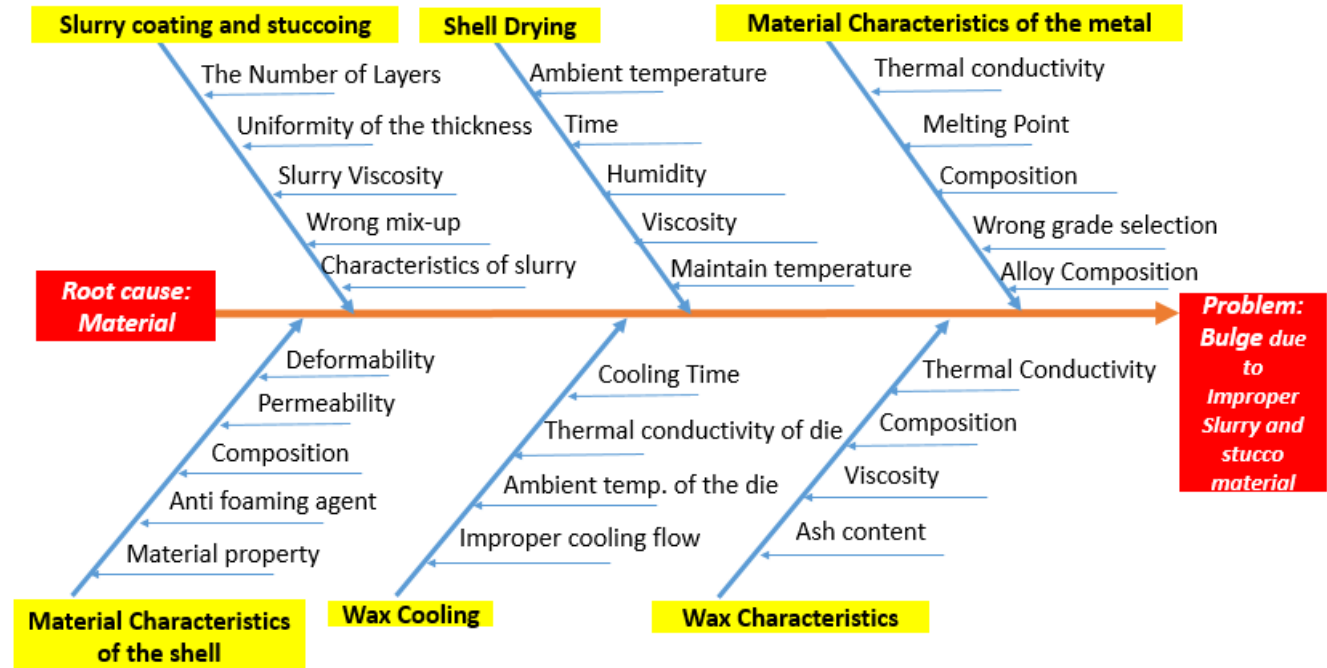
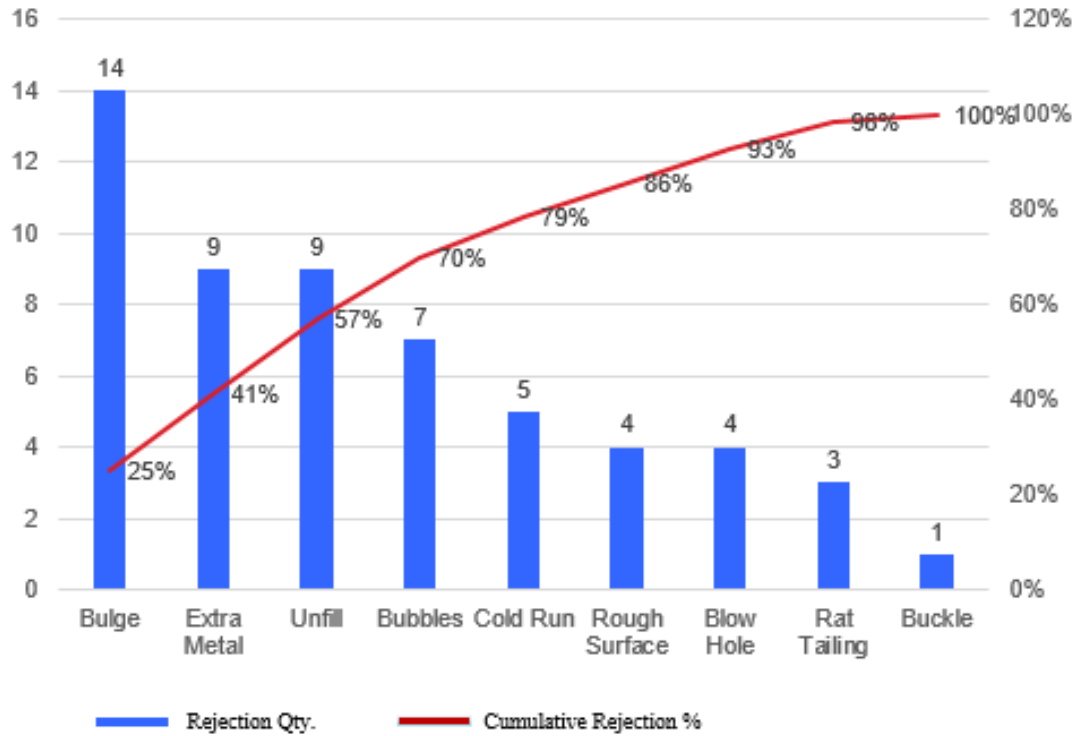


TRIAL - 2	SEQUENCE OF SLURRY CONSUMPTION					
	PRIMARY COATING SLURRY	CONSUMPTION	SECONDARY COATING SLURRY	CONSUPTION	BACK-UP COATING SLURRY	CONSUPTION
	Zircasil	75 Kgs.	Siluminate	60 Kgs.	Clay-200	60 Kgs.
	Colloidal Silica	18 Kgs.	Colloidal Silica	30 Kgs.	Colloidal Silica	30 Kgs.
	Wetting Agent	0.150 MI	Wetting Agent	0.150 MI	Wetting Agent	0.150 MI
	Anti foaming agent	0.150 MI	Anti Foaming Agent	0.150 MI	Anti Foaming Agent	0.150 MI
Demineralised Water	2 Litrs.	-	-	-	-	

TRIAL - 2	#	SLURRY COATING	STUCCO	DRYING TIME (in Hrs.)	VISCOSITY (B4 Cup in Sec.)
	1	Primary Coating	Zircon Sand	22-24	90-120
	2	Secondary Coating	AS 50/80	12-14	20-30
	3	Secondary Coating Seal Dip	-	08-10	23-25
	4	Secondary Coating	AS 50/80	12-14	20-30
	5	Back-up Coating	AS 30/80	08-10	20-30
	6	Back-up Coating	AS 30/80	08-10	20-30
	7	Back-up Coating	AS 16/30	08-10	20-30
	8	Back-up Coating	AS 30/80	08-10	20-30
	9	Back-up Coating	AS 16/30	08-10	20-30
	10	Back-up Coating	AS 16/30	08-10	20-30
	11	Back-up Coating - Seal Dip	-	12-14	23-25
Total Hours				136	

- Changing the sequence of coating with same temperature and humidity maintained.
- The bulge rejection quantity is fall down
- 10 coatings are made and their total drying time is 136 hours.
- Based on the result, we are going to take additional trial

Results for Trial-1



For Trial-1 study, we change the slurry sequence with the same material. But the bulge problem till persist After analysis, we suspected the material characteristics. So procure 3 types of imported material and conduct the trial. The results are shown in next page.

Data Generation - Trial – 2

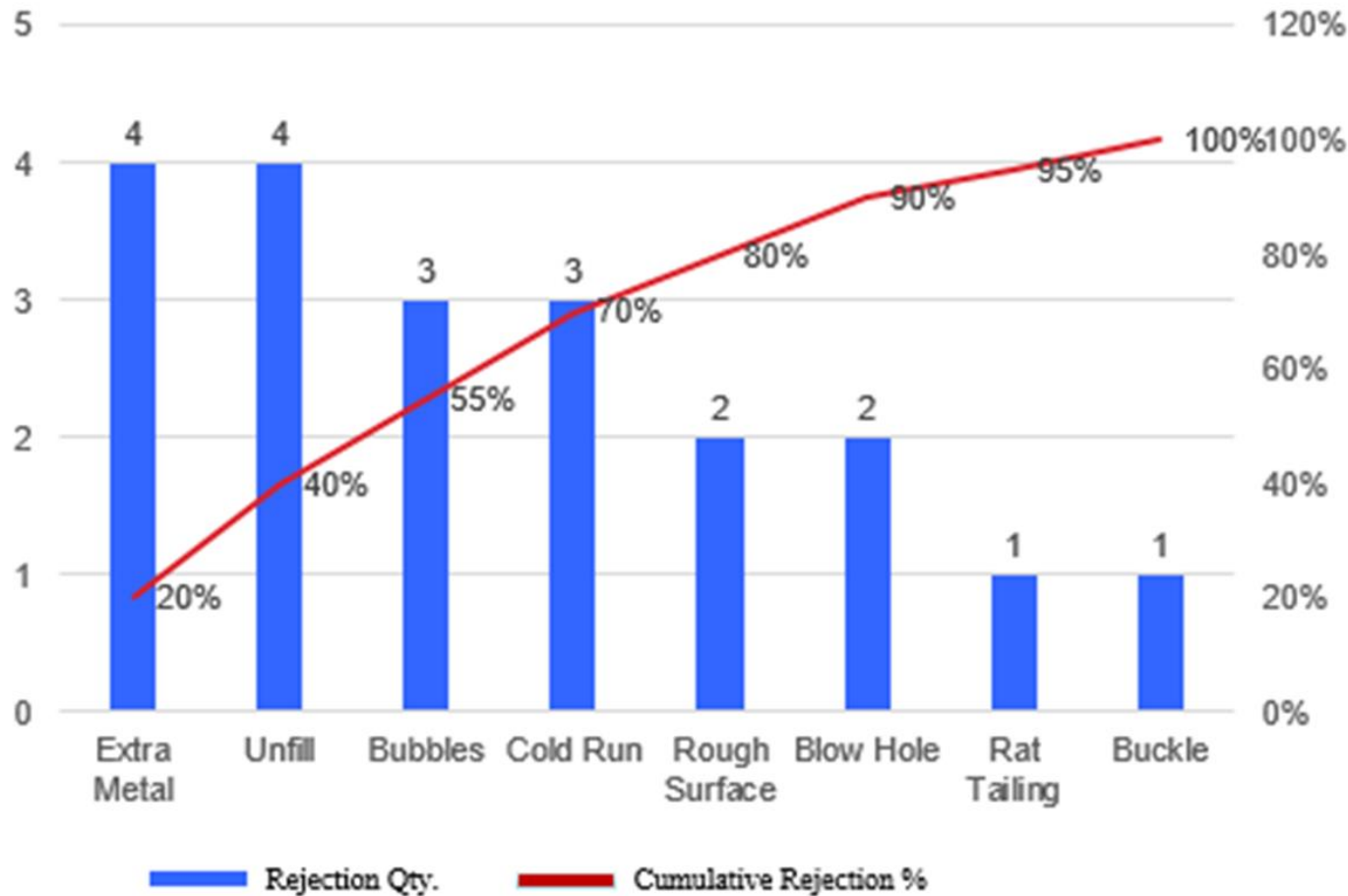


TRIAL - 3	SEQUENCE OF SLURRY CONSUMPTION					
	PRIMARY COATING SLURRY	CONSUMPTION	INTERMEDIATE COATING SLURRY	CONSUPTION	BACK-UP COATING SLURRY	CONSUPTION
	BI Zircon EU-200f	75 Kg	BI TMM - 30i - Colloidal Silica	98Kg	BI TMM - 30i - Colloidal Silica	60 Kg
	Shell bond 413i	18 Kg	Fused Silica FC-1109	25 Kg	Fused Silica FC-1109	30 Kg
	BI PS 9400 Wetting Agent	75 MI	Fused Silica 'C' -200F BI	100Kg	BI PS 9400 Wetting Agent	0.150 MI
	BI AF 9450 Anti-Foam	30 MI	Fused Silica 'C' -120F BI	25Kg	BI AF 9450 Anti-Foam	0.150 MI
	Demineralised Water	1.5 Kg	BI SBAI Polymer	2 Kg	Demineralised Water	-
		BI PS 9400 Wetting Agent	50 MI			
		BI AF 9450 Anti-Foam	50 MI			

TRIAL - 3	#	SLURRY COATING	STUCCO	DRYING TIME (in Hrs.)	VISCOSITY (in Sec.)
	1	BI Primary Coating	Zircon Sand	07	70-80 (B4 Cup)
	2	BI Intermediate Coating	Fused Silica 'C' -50+100 BI	12	6-7 (BI Cup)
	3	BI Intermediate Coating	Zircon Sand	24	5-6 (BI Cup)
	4	BI Intermediate Coating	Fused Silica 'C' -50+100 BI	24	6-7 (BI Cup)
	5	BI Intermediate Coating	Fused Silica 'C' -30+50 BI	12	11-13 (BI Cup)
	6	BI Back-up - Seal Dip Coating	-	12	11-13 (BI Cup)
Total Hours				91	

- Changing the imported material and the mix-up composition as suggested by supplier. Dryness time and viscosity also changed
- Based on the trial-2, the bulge problem has been eliminated. Other problems are fall down
- 10 coatings are made and their total drying time is 91 hours.

Results for Trial-2

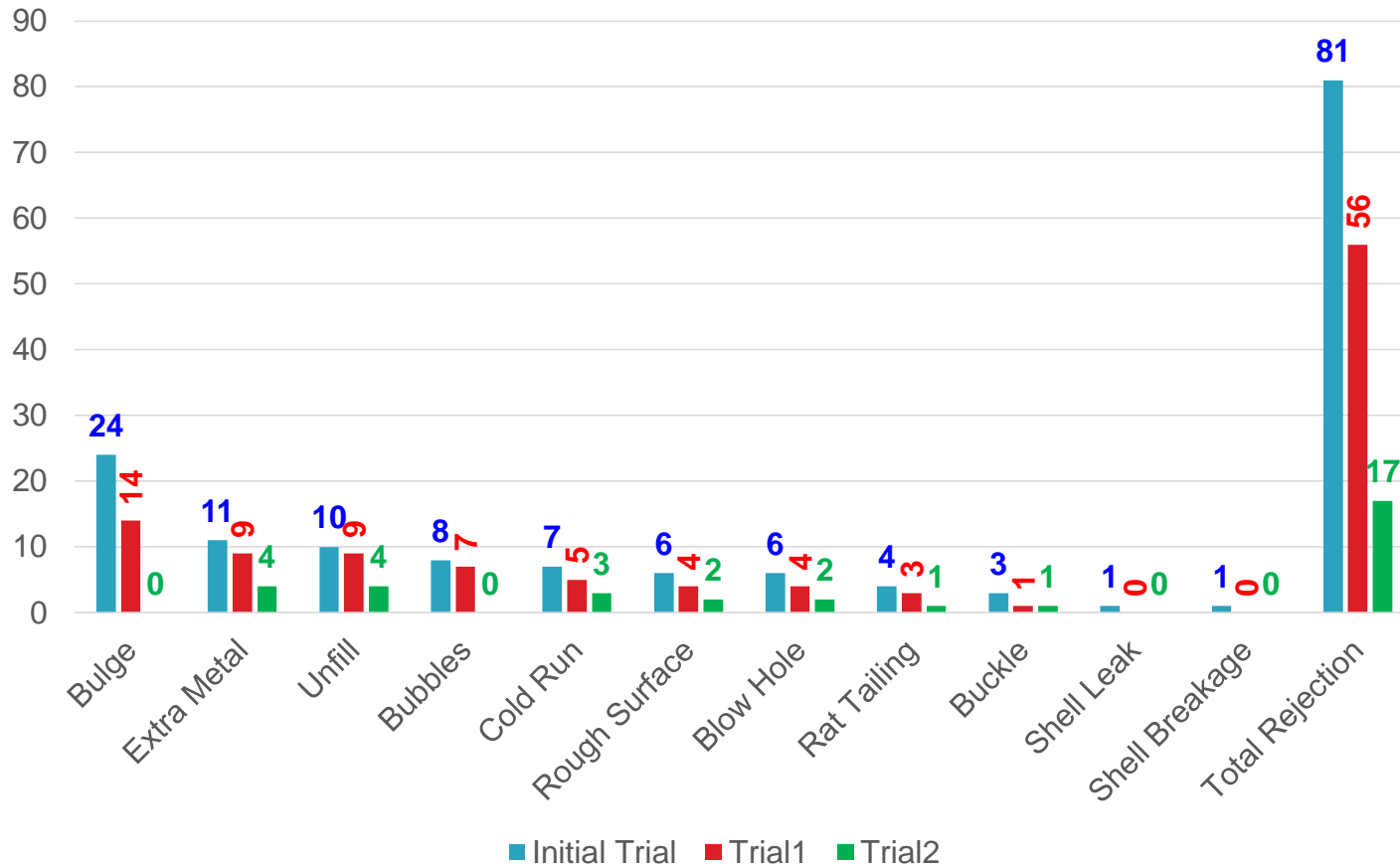


- After material changed, the bulge problem has been eliminated.
- For extra material and Unfil rejection quantity also reduced
- Other two types of imported materials trials going on.. We are waiting for their results

Results and Trends



Trial Rejection summary



Initial Trial	Total Trial Quantity	300
	Total Rejection	81
	Percentage of Rejection	27%
Trial - 1	Total Trial Quantity	300
	Total Rejection	56
	Percentage of Rejection	19%
Trial - 2	Total Trial Quantity	300
	Total Rejection	17
	Percentage of Rejection	6%

Observations & Conclusions



- The characteristics of slurry and stucco material huge impact on the product to reduce the rejection
- Depends upon the product, need to change the slurry and stucco material

Summary and Future Work



- By conducted the trial, we eliminate the bulge problem in the oil flow of the seal plate
- The coating time has been drastically reduced
- The imported material cost is high. Any how, full fill our customer requirements without any delays of shipment
- Further 2 trials are going and waiting for its results
- The same trials will be horizontally deployed to other parts also

Acknowledgements



- Mr. Puneeth