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BLOW HOLE CONTROL IN HIGH PRESSURE DIE CASTING

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Abstract— Though I have such small experience in numbers, out my this small die casting experience I have observed all die casters face blow hole defect in there casting. You can say 35 to 40 % of it 100% rejection. Are blow hole parts. This is the only reason I choose one of practical shop floor problem to analyze and give best solution.

What I observe most of the die casters don't have a proper methodology to solve problem here I will give you proper methodology to solve problem particularly for blow hole. Though this work I try to give some logical solutions to solve blow hole problem in casting. In this work I used to meteorological approach, runner design re-validation, process re validation, sludge factor calculation., Try to make relation between bend Vs blow hole, machining margin Vs blow hole and rise time Vs metal travel time. We also do slow shot validation to prevent air entrapment also we will share fair result.

Keywords—die casting, blow hole, casting pressure, intensification, runner, rise time, sludge factor, slow speed, bend status and machining margin.

I. INTRODUCTION

We are at steady die casting solutions work to make best die casting process. In addition to this work, we try to give best blow hole defect control methodology.

Blow hole is a defect in a casting caused by the escape of gas.

Image -1:



II. PROBLEM

As general as we all know blow due to some air entrapment some where in casting. Even after that there were lot of concussion about what is it, is it gas porosity? or its shrinkage porosity.

Problem is that without adopting any methodology we start to solve problem in general which will not give sunstable result or huge variation result. Which convert in anger or frustration due to that there some more unwanted action taken place and situation will go out of control.

In this work area there is a die casting part which have a rejection 28% of blow hole after machining which add machining cost also, transportation cost (Machining at customer end). So problem may defined in categories;

1. Internal team dispute.
2. Some of loose his job.
3. Team confidence legging.
4. Process cost increase.
5. Customer dissatisfaction.

Image -2:

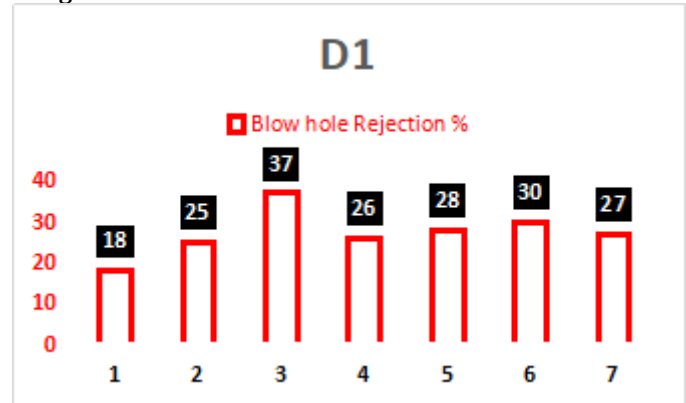


Image -3:

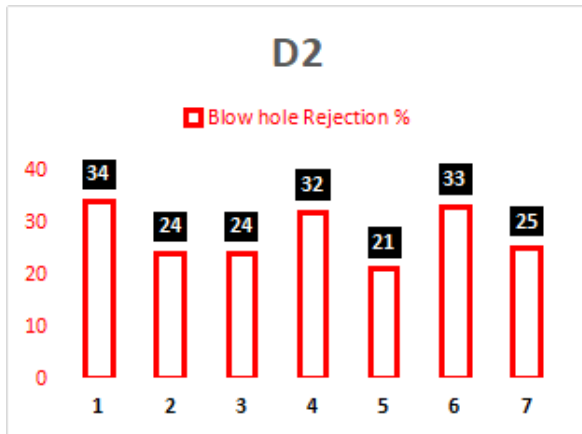
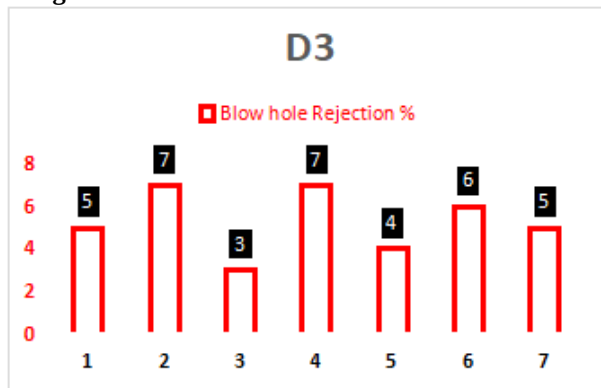


Image -4:



III. ANALYSIS

3.1 Reason for blow hole

Category	Measure	Reason	Countermeasures
Shrinkage porosity	Visually(Un even shape)	§ Wall thickness variation	§ Balanced by adding overflow near that area.
		▪ Thermal balancing of die unbalanced	Balanced by adding or removing cooling line
		§ Less metal pressure	§ Check for correct pressure
		§ less si%	Check for correct %
		§ less biscuit thickness.	Check for correct thickness.

Category	Measure	Reason	Countermeasures
Gas porosity	Visually(Sphere shape)	Excess plunger lubrication	Check & avoid putting lubricant in front of the tip, use less amount
		Wet die insert	Check dry insert before closing
		Undesired slow shot velocity	Calculate desired slow shot velocity
		Metal treatment (Degassing, cleaning)	Check & verified
		Sharp metal entry through runner	Check there is any sharp edge and blind end.
		Small size vent or jam	Check for correct size or clean

3.2 Process parameter

PARAMETER	UNIT	D1	D2	D3
1 N.O. OF CAVITY	NO.	One	One	One
2 OVER FLOW WT.	W1(Gm)	215	215	215
3 PRODUCTION WT.	W2(Gm)	1250	1175	1220
4 RUNNER WT.	W3(Gm)	875	915	675
5 CASTING WT.(W1+W2+W3)	WT(Gm)	2340	2305	2110
6 GATE PASSING WT.(W1+W2)	Wg(Gm)	1465	1390	1435
7 CASTING VOLUME	Vt=WV/2.5	900	886.538462	811.5385
8 BISCUIT THICKNESS	mm	24.4	27.43	17
9 TIP DIAMETER	d (mm)	80	80	80
10 SLEEVE CROSS AREA	As(cm2)	50.24	50.24	50.24
11 TIP FULL STROKE	L1 (mm)	530	530	530
13 SLEEVE CAPACITY	Vs=As*L1(cm3)	2662.72	2662.72	2662.72
14 SLEEVE FILL UP RATIO	Sc=Vt/Vs*100	33.80	33.29	30.48
15 PRODUCTION WT. RATIO	Pc=W2/Wt*100	53.42	50.98	57.82
16 GATE AREA	Ag	2.9	2.5	3.0
17 GATE RATIO	K=As / Ag	17.32	20.10	16.75
18 TIP LUBRICATION	MANUAL	AUTO	AUTO	AUTO
19 DIE LUBRICATION	MANUAL	AUTO	AUTO	AUTO
20 GATE VELOCITY	M/S	72.76	84.5	70.34
21 GATE AREA REQUIRED	CM^2	3.1	2.97	3.01
22 DISCHARGE@GATE VELOCITY	M^3/S	27	26.5	27.5
23 DISCHARGE@45M/S	M^3/S	13	13.25	13.75
24 SLOW SHOT VELOCITY	M/S	0.18	0.18	0.2

3.3 Sludge factor calculation

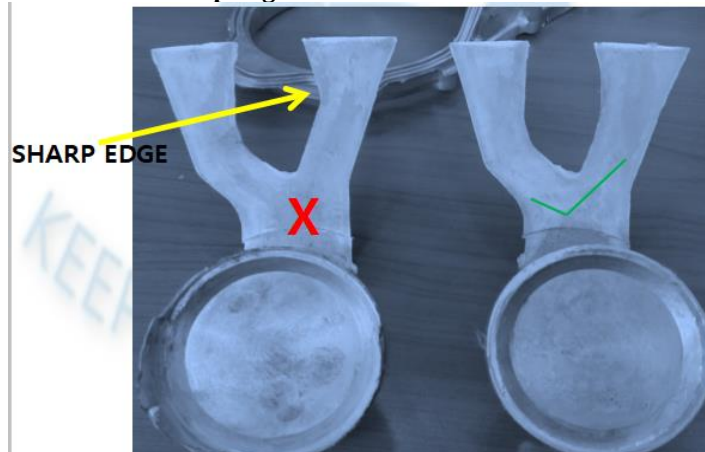
Sludge factor (SF)

$$(SF) = (1 \times \text{wt\% Fe}) + (2 \times \text{wt\% Mn}) + (3 \times \text{wt\% Cr})$$

$$= (1 \times 8) + (2 \times 2) + (3 \times 0.04) \\ = 1.32$$

NOTE: IT SHOULD BE ≥ 1.85

3.4.1 Runner sharp edge

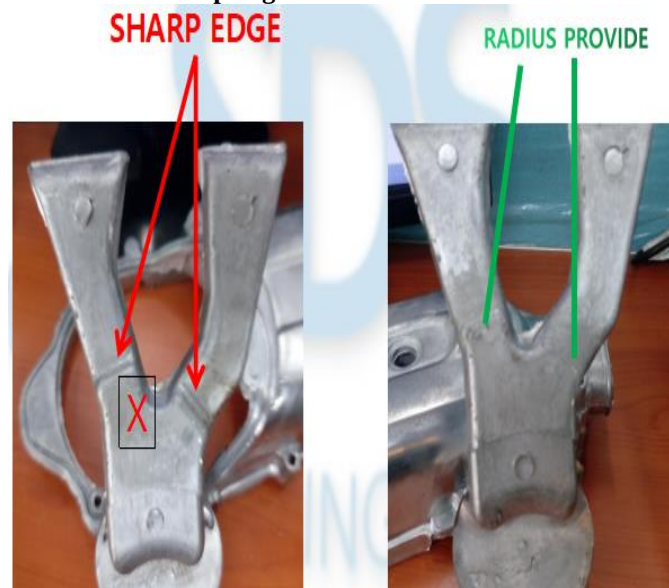


3.4.3 Runner design analysis for die no D1 & D2



ZONE	AREA (CM ²)	ZONE	AREA (CM ²)
A	10.21		
C1	4.38	C2	5.94
D1	4.28	D2	5.70

3.4.2 Runner sharp edge



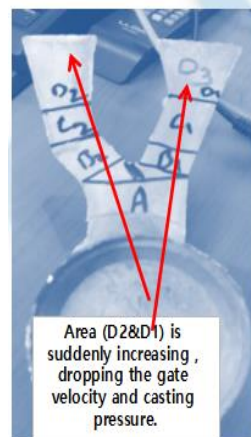
3.5 Check for excess machining margin

As cast	23.2MM	
After m/c		MACHINING CUT
D1	22.34MM	0.86MM
D2	22.14MM	1.06MM
D3	22.26MM	0.94MM

3.6 Bend analysis

D3		D2		D1	
Min waarpage observe	Max waarpage observe	Min waarpage observe	Max waarpage observe	Min waarpage observe	Max waarpage observe
12.49	12.64	12.25	12.31	12.44	12.53
11.95	12.74	12.17	12.5	12.34	12.58
11.61		11.98	13.32	12.23	
11.53		11.7		12.2	
		11.61		12.14	
				12.13	
				12.06	
Total Bend	1.21		1.71		0.52

3.4.3 Runner design analysis for die no D3

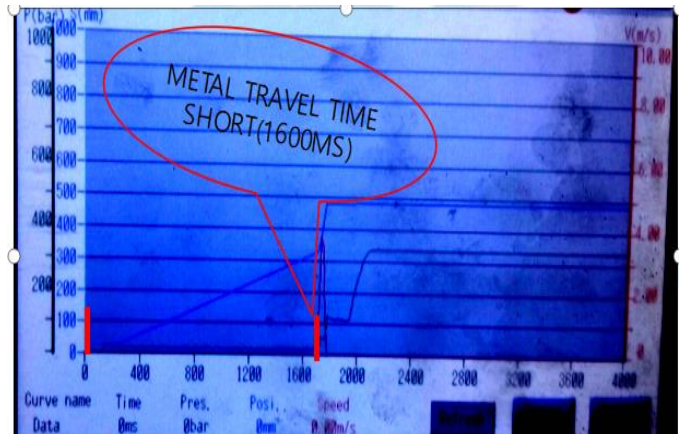


D3			
ZONE	AREA (CM ²)	ZONE	AREA (CM ²)
A	7.35		
B1	3.6	B2	2.4
C1	2.4	C2	2.4
D1	4.2	D2	3.48

Area (D2&D1) is suddenly increasing, dropping the gate velocity and casting pressure.

3.7 Blow hole status after machining

D3		D2	
BEND	STATUS	BEND	STATUS
0.8	ok	0.8	ok
0.9	ok	0.52	ok
0.8	ok	0.3	blow hloe
0.8	ok	0.9	ok
0.7	ok	1.1	ok



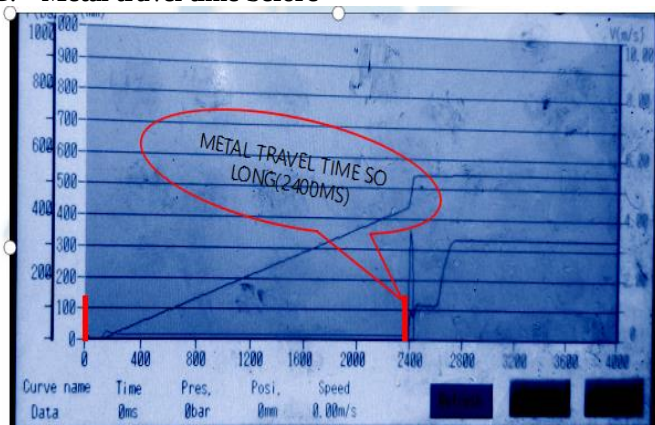
D. Slow shot speed validation

IV. ACTION

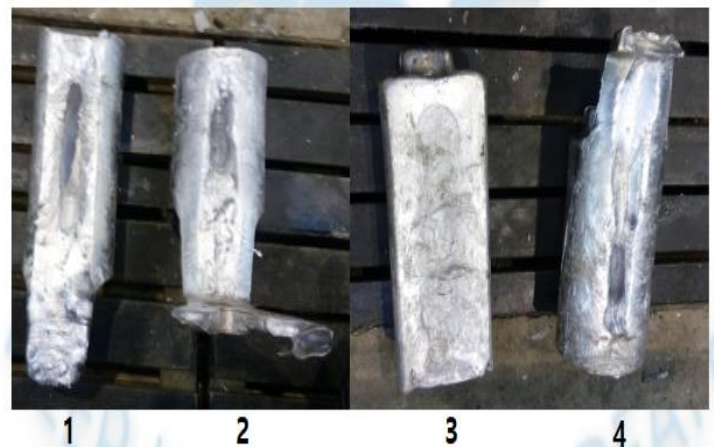
A. Runner design guideline

1. Runner area must be ever-decreasing from sleeve or sprue to gate.
2. Runner design must be smooth and rounded.
3. Smooth and ever-decreasing runners can be made much smaller and more efficient, saving money and energy.
4. Start at the casting, increase area 3% to 5% at every bend, and 3% to 10% at a Y junction.
5. If possible, make the distance to each cavity the same.

B. Metal travel time before



C. Metal travel time after



TRIAL	DISTANCE TRAVELBYPLUNGER(MM)	SLOW SHOT VELOCITY(M/S)
1	360	.15
2	380	.15
3	300	.2
4	340	.16

V. CONCLUSIONS

Thanks to all my team member. Thanks to management for their patients. In this work first we identified the type of porosity for that we use Zoom camera , X-ray and cut section. So here we find both type of porosity, accordingly we move further and take action accordingly. But before that we have to measure and analyze few things.

1. We measure blow hole % with respect to die's. e.g. D1, D2 and D3. We found D1 and D2 has higher blow hole % than D3.



2. So first of all we categorize the blow hole as one is shrinkage porosity and second is gas porosity.

3. Write down the all possible cause of that type of porosity and it's countermeasure.

4. Here we analyzed one by one each reason and action taken care accordingly.

5. We have checked for 24 no's process parameter, sludge factor, runner design, part bend analysis, excess machining margin, metal travel time and slow shot speed.

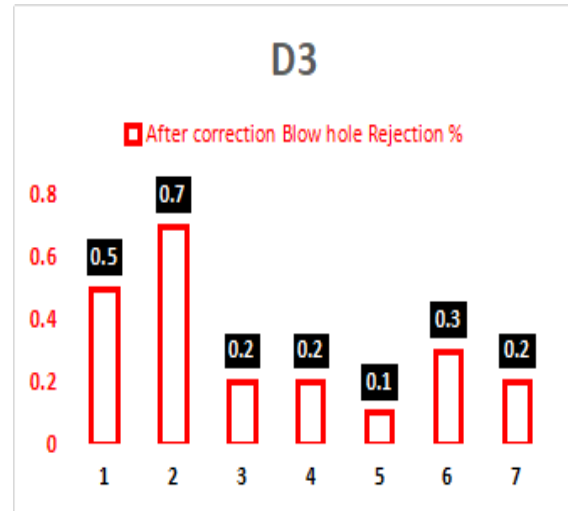
6. As a conclusion we stop D1 and D2 die's for further mass production till action decided for these two die. We keep on running D3 die for mass production with following correction's

- We remove sharp edges from runner.
- We decrease metal travel time by reducing first phase length.
- We have re validate slow shot speed for minimum air entrapment.

5.1 There are other few things also taken care:

- Air vent should be clean.
- Melting temperature variation should not be more than ± 5 degree centigrade.
- Biscuit thickness variation should be ± 2 mm.
- N2 pressure should maintain as per machine standard in both accumulator (a) fast shot accumulator (b) intensification accumulator.
- We have to ensure there should not be any water leakage in die.
- Ensure there should not be any spray droppage on die after die coating spray function, in case of automatic spray unit.
- Ensure die should be fully dry after spray.
- Remove spray vapour from near die, by using fan or duct.
- Ensure plunger lubrication should not mix with alloy during plunger lubrication.
- Molten metal should be clean

VI. RESULT



Again thanks to all my team member,
“keep learning till death”.

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