

pair wise comparison of each parameter resulting weights are calculated from the values obtained from decision matrix. Thus priority and rank of each parameter was obtained. The different parameters considered are: green compression strength, moisture content, hardness, permeability, sand particle size, adhesiveness, plasticity and compatibility. The resulting weights are based on the principal eigenvector of the decision matrix. Figure 6 shows the decision matrix after pair wise comparison of parameters.

Principal Eigen value = 8.884
 Eigenvector solution: 7 iterations, delta = 1.2E-8

	1	2	3	4	5	6	7	8
1	1	1.00	2.00	3.00	6.00	7.00	9.00	8.00
2	1.00	1	2.00	3.00	2.00	6.00	8.00	9.00
3	0.50	0.50	1	3.00	4.00	5.00	6.00	5.00
4	0.33	0.33	0.33	1	4.00	9.00	8.00	8.00
5	0.17	0.50	0.25	0.25	1	1.00	2.00	1.00
6	0.14	0.17	0.20	0.11	1.00	1	6.00	4.00
7	0.11	0.12	0.17	0.12	0.50	0.17	1	1.00
8	0.12	0.11	0.20	0.12	1.00	0.25	1.00	1

Figure 6: Decision matrix

Figure 7 shows the priorities and rank of each parameter. These are the resulting weights for the criteria based on the pair wise comparisons.

Number of comparisons = 28
 Consistency ratio CR = 9.0%

Category	Priority	Rank
1 green compression strength	27.0%	1
2 moisture content	24.3%	2
3 permeability	18.2%	3
4 hardness	16.0%	4
5 particle size	4.7%	6
6 adhesiveness	5.2%	5
7 plasticity	2.1%	8
8 compactibility	2.5%	7

Figure 7: Prioritised parameters

2) Optimization using Taguchi method

The green sand related process parameters considered were, moisture content, green strength and permeability. For optimization of the process parameters, Taguchi based L9 orthogonal array was used for the experimental purpose and was done using Minitab software. Table 5 shows the L9 orthogonal array and Table 6 shows different levels taken from within the range of each parameter.

Table 5: L9 Orthogonal array

Trail No.	A	B	C
1	1	1	1
2	1	2	2
3	1	3	3
4	2	1	2
5	2	2	3
6	2	3	1
7	3	1	3
8	3	2	1
9	3	3	2

Table 6: Different levels of parameters

Process parameters	Range	Level 1	Level 2	Level 3
Moisture content (%)	2.8 – 5	3.2	3.8	4.2
Green strength (KN/m ²)	70 -120	75	85	110
Permeability	60 – 90	65	70	80

The optimized experimental setup, where the response factor percentage defect is minimum was identified. To analyze the results, the Taguchi method uses a statistical measure of performance called signal to noise ratio (S/N Ratio). The S/N ratio values of the percentage defect are calculated using the smaller the better characteristics. Table 7 shows the percentage defect in casting and S/N ratio of different trails of experiment conducted.

Fn. to be maximized: S/N Ratio: Smaller is the Better;
 S/N Ratio = $-10 \cdot \log(\sum Y^2/n)$

Table 7: Experimental orthogonal array with S/N Ratio for % defect

Trail No.	Moisture (%)	Green strength (KN/m ²)	Permeability	% Defect	S/N Ratio
1	3.2	75	68	8.00	-18.0618
2	3.2	85	70	6.50	-16.2583
3	3.2	110	80	6.66	-16.4695
4	3.8	75	70	6.00	-15.5630
5	3.8	85	80	5.33	-14.5630
6	3.8	110	65	6.00	-15.5630
7	4.2	75	80	8.88	-18.9683
8	4.2	85	65	6.15	-15.7775
9	4.2	110	70	6.00	-15.5630

Table 8: Response table for S/N Ratios

Level	Moisture	Green strength	Permeability
1	-16.93	-17.53	-16.47
2	-15.22	-15.52	-15.79
3	-16.77	-15.87	-16.66
Delta	1.71	2.01	0.86
Rank	2	1	3

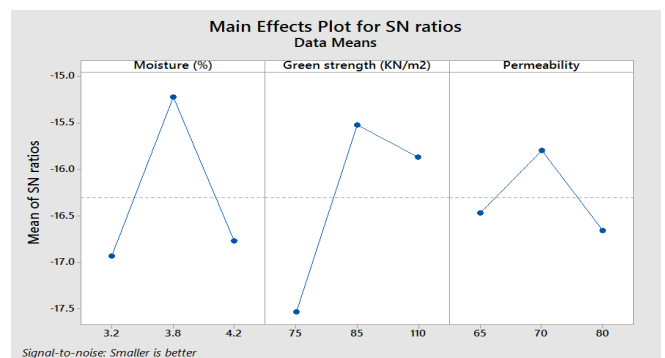


Figure 8: Main effect plot for S/N ratios

The AOM plot in figure 8 shows that the percentage defect is minimum at level 1 for moisture content and green strength and level 3 for permeability.

4. Conclusion

Job safety analysis was used to do safety analysis at the work place. The list of job tasks and the record of the analysis are used to produce an improved set of job instructions and safety measures to reduce hazards at workplace. From the job safety analysis it was found that molten metal burns occur mainly due to poor mould quality and ignoring safety regulations. These accidents could be largely reduced by improving the mould quality and proper practice of job at the workplace by following the job instructions. After the analysis it was recommended to implement automatic feeders with adjustable speed controller for molten metal pouring. Vibrating machine with fan mounted at the bottom for quick settlement of dusts to the ground was also suggested at the shakeout section.

Casting defect analysis was done using Pareto chart and cause effective diagram by identifying and evaluating different defects and its causes, responsible for rejection of casting products. So finally it was found that the manual metal casting operations are done with some negligence and carelessness. So by suggesting some other remedial issues and by implementing them reduces total rejection in casting. This study proves that by means of effective analysis of tools and processes, it is possible to control the casting defects.

The optimized levels of selected process parameters obtained by Taguchi method are: moisture content (level 1): 4.7 %, green compression strength (level 1): 75 KN/m², permeability number (level 3): 80. Design of experiments method such as Taguchi method can be efficiently applied for deciding the optimum levels of process parameters to have minimum rejection due to defects in casting.

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