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ANALYSIS OF USE OF TAGUCHI METHOD WITH ITS TOOLS IN DIE CASTING FOUNDRY FOR OPTIMSATION OF VARIOUS PARAMETERS

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Abstract: *Die casting is a typicalmanufacturing process that can produce geometrically composite parts withthe practiceand use of reusable mould or dies. Accuracy and quality of products are the first need of customers that must be achieved by presenting high quality productsin die casting to the customers.*
Die casting process have many problems and difficulties due to various defects problems, Some defects are blowholes, improper filling, scratch marks, weld lines, cracks, cold shut, gas porosity, blisters, ejector pin marks, hot tears etc. Main reasons of these defects are formed due to improper and unsuitable design of dies, or due to incorrect parameters such as, Melt temperature, Holding time, and Injection pressure, Rate of cooling, Velocity of flow of molten metal, cycle time, cooling circuits and other such parameter of die casting process. Sometimes these defects rise after manufacturing of die and component production, which will be loss to the organization as there will be wastage of money, time and material and also problem of customer dissatisfaction due to quality problems.
This review paper discuss use of taguchi method, DOE and Analysis of Variance (ANOVA) for optimization of various parameters to reduce defects and improve quality by various researches in there research paper.

Key Words:*-Die Casting, Taguchi Method, FoundryANOVA, DOE defects*

I INTRODUCTION

Die casting is a moldingor casting process in which the molten metal is injected under high pressure andvelocity into a split mould die. Die casting is also called pressure die casting. Pressure Die Casting Process (PDC) is a complex and complicated manufacturing process. In a usual die casting machine thehot molten metal is poured in the shot sleeve through a ladle after the die is closed. A movement of plunger or piston forces the metal through the die.Due to this the moveable part matches with the fixed part. Though, generally it is done in two stages only. The plunger starts firstly with a low velocity, then the velocity increases during the piston's motion at a changeover position, the length of travel of the piston in the low velocity up to the changeover point is known as first phase length and the injection pressure is drops at the end when nearly all the liquid metal is injected into the die and solidifies in dies.For the period of this process taking place inside the shot sleeve the flow of the metal in the shot sleeve before plunger should be in laminar if these take momentum in first phase length, and injection pressure are not set appropriately the flow of metal will distressed and convert into turbulence and there will be possibility of development of porosity during process (Kulkarni Sanjay Kumar 2013).

In a classic die casting machine the molten metal is poured in the shot sleeve through a ladle. Die casting is classified in twocategory namely- hot chamber and coldchamber. In hot chamber die casting Metals like zinc, tin and lead alloys are caste which has low melting temperature. In a cold chamber die-casting is use for alloys having high temperature like magnesium and aluminum alloysAluminum dissolves ferrous parts in the die chamber and for this reasonchosen to be used in cold chamber die casting process.(Reference 18)

Die casting process is alsochosen for nonferrous s metal parts of intricate and complicatedshapes. Examples ofproducts are automobiles machines or equipment's, hand tools, computer peripherals, toys, optical andphotographic apparatus etc. Die manufactured with tool steel is used for die casting products having lower melting point nonferrous materials.

IITAGUCHI METHOD

Taguchi method is a set of experimentation techniques based on statistical principles and utilizing engineering knowledge developed by Japanese quality expert, Dr. Genichi Taguchi.

Dr. Taguchi has recommended a method based on experiments of orthogonal array which gives lesser variation with optimal settings of experimental parameters. Due to this it result in the blend of experimental design together with optimum control parameters helps in obtaining the best results Orthogonal arrays (OA) gives a set of well poised experiments and signal-to noise ratios (S/N), which are log functions of output, commonly known as objective functions. Optimization of objective function under a set of the constraints helps in optimization of process parameters

With help of taguchi methods a company t rapidly and accurately get technical information to design and produce low-cast, highly reliable products and processes. Its most advanced applications allow engineers to develop flexible technology for the design and production of families of high quality products, greatly reducing research, development, and delivery time.(Rupesh Kumar Tiwari et al 2015)

III TAGUCHI PARAMETER DESIGN

In recent years the he Taguchi method has been successfully applied for designing experiments. The method can be classified into three sub-methods, nominal-the-better, larger-the-better, and smaller-the-better, depending on the desired mean square deviation. The mean square deviation is considered to be the average performance characteristic value for each experiment.(Yung-Kuang Yang et al 2014)

Taguchi method is one of the efficient, proficient and well organized problems solving tools to upgrade the performance of products and processes with a significant reduction in cost and time involved. Taguchi's parameter design offers a systematic approach for optimization of various parameters with regard to performance, quality, and cost (Syrcos 2003 [7], Taguchi 1986 [8]).

Taguchi parameter design can be used for reducing cost and improving quality by making actual use of experimental design methods. This includes the determination of parameter values that are least sensitive to noise .When the goal is to design a process or product with high stability and reliability, parameter design is the most important step in which the functional non linearity is used to best advantage. Firstly parameters that are to be optimized are selected carefully. A cause and effect diagram can be used for recognizing the parameters that affects the response. (Senthiil, P. V et al).

Coleman and Montgomery (1993) identified that the design of experiments (DOEs) is an experimental technique that supports to investigate the best groupingsor combinations of process parameters, changing quantities, levels and combinations in order to obtain resultsstatically reliable. According to Taguchi (1993) the parameters which exert a great dealof influence on the die casting process can be adjusted to varying levels of intensity sothat some settings can result in robustness of the manufacturing process. Taguchi hasintroduced several new statistical tools and concepts of quality improvement thatdepend heavily on the statistical theory of experimental design.

IV APPLICATION OF TAGUCHI METHOD IN DIE CASTING PROCESS

Taguchi emphasized the fact that the most intangible edge in the global competition was the galvanizing pride of excellence. The metal-casting process(die casting), in general, involves a large number of parameters affecting the quality of the products. The variation in the quality of the product by uncontrollable factors (noise factors) can be estimated by Taguchi's approach of determining thesignal-to-noise (S/N) ratio(Bagchi, T.P. 1993).

Steps of Taguchi method in Die Casting process
The basic steps for achieving the above target are summarized below :(V. D. Tsoukalas)

- Select the die casting machine and process parameters that cause variation of various parameters
- Complete the die casting process under the experimental conditions read out by the selected orthogonal array (OA) and parameter levels and collect various data.
- Analyze the data. An analysis of variance (ANOVA) table can be generated to determine the statistical significance of the parameters. Response graphs are plotted to determine preferred levels of each parameter.
- Make decisions regarding optimum settings of the control parameters predict the results of the new optimum levels of each of the parameters.
- Verify and Validate that the optimum settings result in the predicted improvement in the die casting defects.

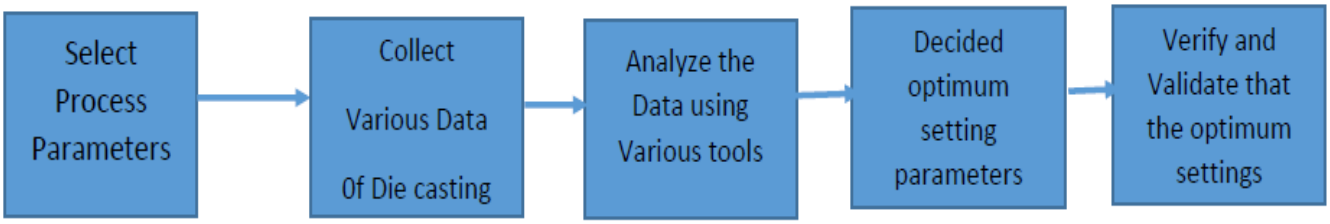

Figure-1 Steps of Taguchi method in Die Casting Process

V RESEARCH METHODOLOGY

In this paper total 11 different case study of casting The Die casting foundry Company for critical examination Design Of experiment (DOE& analysis of variance (ANOVA) for quality improvements through optimization in a the foundry. All the case studies which are selected in this paper are from established publications to show the real research The main aim of this study is to find out the benefits which Taguchi methods with design of experiments and ANOVA in the foundry for quality improvement, For this Two different table are prepared for critical analysis Table 1 shows Overview of Research papers with publications. Authors name case study. with objective of study.(Table-1) .Table -2 show various parameter taken for optimization, tools/ methods used, a method used for deciding significate parameters, No of experiments and Level Benefits/Result Achieved and Critical success factor achieved. Table-3 shows final result obtained in each case study.

Table-1 General Overview of Case Industries (Foundries) with use of Taguchi method, Design of Experiment (DOE) & ANOVA.For all Case Study DT-1 to DT-11 Reference is given at last)

Sr NO.	Title of Paper	Author	Journal Name and Publication details	Case study And objectives
DT-1	Optimization Of Process Parameters In Cold Chamber Die Casting Process Using Taguchi Method	Senthiil, P. V., M.Chinnapandian and Aakash Sirusshti	IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 1 Issue 6, August 2014.	In this paper case study of In industrial component (Front Wheel Hub I casting), having blow hole problem has been taken. Main objective of study is application of Taguchi methodology in identifying the optimum process parameters in order to improve the casting quality
DT-2	Investigating Die Casting Process Parameters To Identify The Optimized Levels Using Taguchi Methods For Design Of Experiment (DOE)	U.G.Mulla J.G, V.V.Potadar, S.S. Kulkarni	International Journal of Scientific Research and Management Studies (IJSRMS) Volume 1 Issue 10, pg: 317-329	Case study atAdvent Tool Tech Pvt. Ltd., Pune.Main objective is to get defect free part in minimum cycle time by optimization
DT-3	Minimum Porosity Formation in Pressure Die Casting by Taguchi Method	Quang-Cherng Hsu and Anh Tuan Do	Hindawi Publishing Corporation Mathematical Problems in Engineering Volume 2013, , 9 pages	This Case study of die casting is for Automobile starter motor casing made of aluminum ADC10 die casting . Main objective is to construct an appropriate multivariable linear regression analysis modelfor developing a robust performance for pressure die casting processes.
DT-4	The effect of die casting machine parameters on porosity of aluminium die castings	V. D. Tsoukalas	Int. J. Cast Metals Res., 2003, 15, 581-588	Case study carried out at in the Greek Die Casting Industry Vioral S.A. The primary objective of this research is toinvestigate the effect of machine relatedparameters on porosity formation in thealuminum die casting process.
DT-5	Experimental Investigation And Defect Analysis Of	Haridasu Deepthi, Haridasu Prasada	International Journal of Mechanical And	Case Study carried out at M/s JDP TOOL TECH,

	High Pressure Die Casting For Main Housing Load Cell	Rao	Production Engineering, ISSN: 2320-2092, Volume-4, Issue-10, Oct.-2016	themanufacturers of casting dies and Injection mould. The main objective is to carried out set of analysis is carried on main housing load cell component to ensure that design and other Parameters are safe and efficient.
DT-6	Optimization of Process Parameter to Enhance the Impact Strength of Squeeze Cast Brass Alloy	Deepak Singh Munish Chhabra Vineet Tirth	MIT International Journal of Mechanical Engineering, Vol. 5, No. 1, January 2015, pp. 43-48	Case study for obtaining the maximum impact strength of brass alloyusing Taguchi's design of experimentation method.Main objective is to obtain various parameters to get obtained in order to get the maximum value of impact strength of squeeze cast brass alloy.
DT-7	Study of effect of process parameter setting on porosity levels of aluminium pressure die casting process using Taguchi Methodology	Kulkarni Sanjay Kumar, J K Sawale , Sampath Rao	Journal of Mechanical and Civil Engineering (IOSR-JMCE) Volume 9, Issue 4 (Nov. - Dec. 2013), PP 12-17	Case study carried out at Tyche die Cast Company. The main objective of this paper to study and examined effect of die casting process parameters on porosity in aluminum alloy SAE 308 by using Taguchi method
DT-8	Optimization of process parameters in cold chamber Pressure die casting using DOE.	Md Ainul Haque, Prof Babuli Kumar Jena ,,Prof Dilip Kumar Mohanta	International Research Journal of Engineering and Technology (IRJET Volume: 04 Issue: 04 | Apr -2017	Case study for a pressure die casting process of aluminum The Main aim is optimization of process parameters of an aluminum pressure die casting operation.
DT-9	Die-Casting Parameter Sizing for AZ91D in Notebook Computer Base Shell	Yung-Kuang Yang and Chorng-Jyh Tzeng	Materials and Manufacturing Processes, 21: 489–494, 2006 Copyright © Taylor & Francis Group, LLC	This study investigates die-casting process parameter optimization for magnesium alloy AZ91D.The main aim of this case study is examined the optimization of die-castingprocess factor and levels using the Taguchi method.Also, ANOVA can be applied to examine which parametersmost influence the die-casting process
DT-10	Optimization of Aluminum Die Casting Using Artificial Neural Netwotk	C. Mohanty, B. K. Jena	International Journal of Emerging Technology and Advanced Engineering	In the present paper, optimization of process parameters of an aluminum die casting operation is discussed.

			Certified Journal, Volume 4, Issue 7, July 2014)	The quality problem encountered during the manufacturing of a die casted component was porosity and the potential factors causing it are identified through cause-effect analysis.
DT-11	Optimization of the aluminium die casting processbased on the Taguchi method	K S Anastasiou	Proc Instn Mech Engrs Vol 216 Part B: J Engineering	In this paper case study of Greek aluminum die casting company is discuss. The primary objective of this paper is to investigate theeffects of process parameters on porosity formation in the pressure die casting process to improve casting quality.

Table-2 showing SR.No, Various Analysis for critical examination, and Description for each case study shown in Table-1(For all Case Study DT-1 to DT-11 Reference is given at last)

Sr No of paper case study	**Various Analysis or Critical Examination of Each Case Study**	**Description for each paper/case study for column-2 of Table-2**
DT-1	*No of Factors and parameters for Case study*	Total 5 parameters are taken:- Metal temperature (°C), Intensification pressure (kg/cm2).Slow Shot (m/s), Fast shot (m/s), Die holding time (seconds}.
	Tools/Methods used in case study	Cause and effect diagram for blow holes, Orthogonal array, S/N ratio.forFront Wheel Hub I casting. ANOVA :-In order to determine which parameter significantly affect the quality characteristic (casting density), ANOVA is done.
	No of experiments and Level/Output parameters	A L27 Orthogonal array is used with 27 experiments .with 3 level. Output parameters is blow holes defects
	Benefit Achieved	Taguchi method is applied for optimizing the die casting process parameters, and the results obtained using this method is useful in eliminating the blow holes problem in Front Wheel Hub I casting .Simulation results also reveals that under optimized conditions no defect (blow holes) is found in the casting.
	Critical success factor achieved	Combination of optimization techniques along with casting simulation serves as a tool for improving the productivity of the castings to a greater extent, in die casting industries.
	Other Special Tools-/Technique. Methods used in thisCase study	Numerical simulation, The casting simulation was done by using Z-cast v2.6 trial version. The simulation results consist of Flow analysis, Solidification analysis, and Defect analysis, The Multi variable regression equation (MVLR) confirmation test is carried out for density. radiography images.
DT-2	*No of Factors and parameters for Case study*	Total 5 parameters melting temperature, injection pressure, plunger velocity and cooling are taken in this case study(for Magneto Cover 1and 2) Same process parameters for case gear meter.
	Tools/Methods used in case study	Design of experimentation (DOE) performed by using Minitab software. ANOVA
	No of experiments and Level/Output parameters	Level-3 ,L9 Orthogonal array with 9 Experiments. Output parameters:-Various defects
	Benefits/ResultAchieved	The results obtained by DOE are in arrangement with the experimental results without affecting the quality of the die

		casting part and The optimum cycle time in terms of the good quality of the die casting part were attained. The four different criteria used to evaluate the optimum cycle time shows a good correlation among themselves.
	Critical success factor achieved	The utilization of DOE methodology proved to be very efficient, in the analysis of this problem.
	Other Special Tools-/Technique. Methods used in this Case	Regression analysis and Graphical Analysis for cycle time is carried out.(With help of Minitab Software)
DT-3	*No of Factors and parameters for Case study*	Total-5 parameters Holding furnace temperature (◦C), Die temperature (◦C), Plunger velocity, 1st stage (m/s), Plunger velocity, 2nd stage (m/,Multiplied pressure (bars)
	Tools/Methods used in case study	Cause and effect diagram for shrinkage porosity Stada 8.2 software.
	No of experiments and Level/output parameters	L27 orthogonal array use d and Total 27 Experiments carried outWith three level: Output parameters:- Shrinkage porosity
	BenefitsAchieved	In this paper, the optimum process parameters valuespredicted for casting of minimum shrinkage porosity obtained
	Critical success factor achieved	Due to this study resources materials time and money are saved For Experiments all are minimized.
	Other Special Tools-/Technique. Methods used in this Case	CATIA V5R19 software for part product design, The analysis of defects simulated by ProCAST software with Visual-Viewer module can detect many types of disabilities casting and The Multi variable regression equation (MVLR). Matlab software for developing mat lab code of Matlab code for finding optimization shrinkage porosity value.
DT-4	*No of Factors and parameters for Case study*	Total 5 Parameters :- Plunger velocity, 1st phase (m/sec) Fast set point (mm)Plunger velocity, 2nd phase (m/sec) ie cavity filling time (msec)Multiplied pressure, 3rd phase (bars)
	Tools/Methods used in case study	Die casting porosity ANOVA, Orthogonal Array, S/N Ratio
	No of experiments and Level/outpu parameters	L27 orthogonal array use d and Total 27 Experiments carried with three levels. Output parameters:- porosity
	Benefits/Result Achieved	The optimum porosity value was predicted at the optimal Levels of die casting machine parameters) and was found: Optimum casting porosity= 1.58%.
	Critical success factor achieved	Finding out that die casting machine parameters have significant effects on porosity formation in complex aluminum die-casting - as used in this investigation by experimental procedure
	Other Special Tools-/Technique. Methods used in this Case	Estimation of mean porosity
DT-5	*No of Factors and parameters for Case study*	Total two input parameters :- Fill Time (A), Die Temperature (B)
	Tools/Methods used in case tudy	Orthogonal Array, Design of Experiment(DOE)
	No of experiments and Level/outpu parameters	Total 9 Experiments with 3 level, output parameters Defects.
	Benefits Achieved	Optimization technique Taguchi is applied to determine the better parameters. After optimizing the parameters, experimental work is done and the component is successfully produced.
	Critical success factor achieved	The optimization of die casting parameters to reduce the time and money to the casting industries by considering thetemperatures and pressures developed when materialis injected in to the die, the parameters which decidesthe quality of component.
	Other Special Tools-/Technique. Methods used in this Case	3D modelling parametric software Creo 2.0, latest version of Pro/Engineer software, Analysis software ,Ansys fluent to analyze the behavior of molten metal at different stages of time observing various variations.CFD Analysis Of Main Housing Load CelL with Fluent. software.
DT-6	*No of Factors and parameters for Case study*	The four parameters at three levelsDie Pressure (MPa) ,Die Temperature (oC), Pouring Temperature(Oc).Squeeze Time(seconds)
	Tools/Methods used in case study	Signal to Noise Ratio Analysis, ANOVA for Impact Strength.

	No of experiments and Level/outpu parameters	Total 9 Experiments with 3 levelOutput parameters:-Impact Strength
	Benefits/Result Achieved	It is found out that Among all parameters, die pressure was the most significant squeeze casting parameter due to the highest percentagecontribution (44.31%).
	Critical success factor achieved	From this paper trail and error methods in manufacturing process of pressure die casting die methods thereby reducing total cycle time and also material wastage in die casting process
	Other Special Tools-/Technique. Methods used in this Case	Muffle furnace for die heating and Resistance furnace for melting brass. Impact Testing Machine for impact strength.
DT-7	*No of Factors and parameters for Case study*	Total 4 Factors The most significant parameters were selected are first phase speed), second phase speed as first phase length Injection pressure
	Tools/Methods used	Analysis of variance (ANOVA),DOE
	No of experiments and Level/output parameters	L9 orthogonal array with five columns and nine rows was used/Output parameters: casting porosity
	Benefits Achieved	Casting porosity was calculated as 0.0625 percentages with a confidence interval ofbetween0.05384 and 0.0.07116 percentages. The results are valid within the above range of process parameters and for the SAE 308 alloy casting.
	Critical success factor achieved	The average value of casting porosity obtained at the optimum setting of die casting parameters was found to be within the predicted confidence interval of the casting porosity.
	Other Special Tools-/Technique. Methods used in this Case	Die casting cell consists of 250 T die casting machine, a holding furnace, an automatic lubrication for inner die surfaces, an automatic metal ladle, robot extractor and shot monitoring system here used for analysis and investigation of different die casting parameters.
DT-8	*No of Factors and parameters for Case study*	Total 4 Parameters:- a) Plunger velocity (b) Molten metal temperature (c) Metal filling time and (d) Hydraulic pressure
	Tools/Methods used in case study	Analysis of variance (ANOVA), Optimization, Regression Analysis, DOE
	No of experiments and Level/outpu parameters	L8 Orthogonal Array with two level/ porosity
	Benefits/Result Achieved	The pressure of the plunger used in the die casting machine and temperature of the liquid aluminum are identified as significant. Artificial Neural Network (ANN) is modelled demonstrated and trained with these process parameters and porosity in order to predict or control the output by optimizing input process parameters.
	Critical success factor achieved	The quality problem encountered during the manufacturing of a die casted component was porosity and the potential factors causing it are identified through cause-effect analysis.
	Other Special Tools-/Technique. Methods used in this Case	Artificial Neural Network (ANN)design to optimize aluminum die casting density.Regression analysis for density with use of MINITAB Software.
DT-9	*No of Factors and parameters for Case study*	Total 4 Factors :- filling pressure, filling speed , , melt temperature , and mold temperature.
	Tools/Methods used in case study	Analysis of variance (ANOVA), analysis of variance (ANOVA)
	No of experiments and Level/output parameters	Orthogonal array L9 with 3 level/Production quality is output
	Benefits/Result Achieved	Fusion slurry velocity is the most significant on the die-casting process in this investigation.
	Critical success factor achieved	For AZ91D die-casting process in the base shell of notebook computers. Finally, the mechanical properties such as stress, elongation, and hardness were investigated, and the abruption surfaces of after tensile test were identified from scanning electron micrographs (SEM).
	Other Special Tools-/Technique. Methods used in this Case	Scanning electron micrographs (SEM), FLOW-3D simulation
	No of Factors and parameters for	Plunger velocity., Molten metal temperature, Metal filling time

DT-10	*Case study*	and ,Hydraulic pressure and Metal fillingtime (ms)
	Tools/Methods used in case study	ANOVA, Optimization,
	No of experiments and Level/output parameters	An orthogonal array, L8 (27), is selected for the present problem having five factors at two levels each
	Benefits Achieved	Porosity and the potential factors causing it are identified through cause-effect analysis and ANOVA
	Critical success factor achieved	The quality problem encountered during the manufacturing of a die casted component.
	Other Special Tools-/Technique. Methods used in this Case	Back propagation Artificial Neural Network (ANN). MINITTAB software Validation Using Regression Analysis for hydraulic pressure.
DT-11	*No of Factors and parameters for Case study*	Metal temperature ,Die temperature Piston velocity (First stage),Piston velocity (second stage) Hydraulic pressure
	Tools/Methods used in case study	Analysis of variance (ANOVA), orthogonal array (OA)
	No of experiments and Level/output parameters	OA with 27 experiments. Output parameters:-output
	Benefits Achieved	A substantial reduction in porosity formation can befound by Taguchi technique implementation in the die casting process
	Critical success factor achieved	Greek aluminum die casting company are given for the purpose of illustrating the practicality and ease of use by industry engineers and managers.
	Other Special Tools-/Technique. Methods used in this Case	Estimation Of Predicted Mean

Table 3 Table 3 shows final result obtained for optimsation of various parameters

Sr no Different case study as per Table No-1	**Final Result obtained by optimization of various parameters shown in table -2 and Methods of Validation or Comparison of Results**
DT-1	• The optimized parameters of this experiment are • Metal temperature-680ºC • Slow shot-0.17 m/s • Fast shot-1.92 m/s • Die holding time -10 seconds • Intensification pressure- 290 kg/cm^{2}For casting density • Radiography images and simulation techniques use for comparison of results obtained under optimized condition
DT-2	• The optimum process parameters with Temperature= 679 0C, Injection pressure=155 bar, Plunger velocity= 1.8 m/sec and cooling time= 5 sec. for optimum cycle Time • Comparison of results are done between DOE result and Experimental Result
DT-3	• The best combination parameters given as follows: holding furnace temperature 700◦C, die temperature 260◦C, plunger velocity, 1st stage 0.35m/s, plunger velocity, 2nd stage 1.5m/s, Multiplied pressure 280 bar for minimum shrinkage porosity(1.6725%) • Thepredicted values of the process parameters and the calculatedare in convincing agreement with the experimental values.
DT-4	• Plunger velocity (1st phase) 0.42 m/sec Fast shot set point 270 mm Plunger velocity (2nd phase) 0.5 m/sec Die cavity filling time 45 msecs Multiplied pressure (3rd phase) 250 bars for Optimum casting porosity= 1.58%. • Comparison of results are done between DOE result and Experimental Result
DT-5	• The better solidification occurs at 8secs injection time, 1.405 bar pressure and 3930C die temperature forReducing cycle time • Solidification analysis is done in Ansys CFD andoptimization is done using Taguchi technique.The obtained resultsparameters are applied practically as shown inexperimental investigation
DT-6	• The optimum conditions within the selected parameter values were found as the second level of die pressure (120MPa), second level of die temperature (100oC), third level of pouring temperature (1000oC) and third level of squeeze time (45 Sec). for maximum impact strength of brass alloy • •Comparison of results are done between DOE result and Experimental Result
DT-7	• The experimental procedure presented that the first phase speed, second phase speed, first phase length and injection pressure are the influential parameters affecting the casting porosity

	foralloy SAE 308. Subsequently the higher level of injection pressure 270 kg/cm² has the most significant effecting.Casting porosity was calculated as 0.0625 percentages • Three confirmation tests were conducted at the optimum setting of the process parameters as recommended by the investigation for comparisons
DT-8	• Firstly, statistical ANOVA method was used to identify the significant controlling factors out of five affecting the density of castings. Then those selected factors are used during the ANN modelling. Hundred experimental observations were collected and used for 70% training, 15% validation and 15% testing.. • The present work discussed an ANN based prediction/optimization model for a pressure die casting process of aluminum.
DT-9	• The optimal parameter combination of the die-casting process corresponded to a fusion slurry pressure of21MPa, a fusion slurry velocity of 80 m/s, a fusion slurry temperature of 660_C, and an initial die temperature of 230_C • The optimal process parameter was experimentally re-runFLOW-3D simulation under the condition.
DT-10	• To test and validate the model, the experimental data is separated into three sets. First, 70% of the observations will be used for training the network and the weights are adjusted to decrease its error. Another 15% of the data will be used to validate that the network is generalizing and to stop training before over-fitting. The last 15% will be used as a completely independent test • The present work talk about an ANN base prediction/optimization model for a die casting process of aluminum. Initially statistical ANOVA method is used to identify the significant controlling factors out of five affecting the density of castings. Then those selected factors are used during the ANN modelling
DT-11	• Optimum casting porosity were asfollows:Metal temperature 800 8C (third level)Die temperature 350 8C (third level)Piston velocity (®rst stage) 0.48m/s (third level)Piston velocity (second stage) 0.5 m/s (first level)Hydraulic pressure 350 bar (third level). • Three confirmation experiments were conducted at the optimum settings of the process parameters recommended by the investigation.

VI CONCLUSION

Taguchi method can be applied for optimizing the die casting process parameters, and the results obtained using this method is useful in eliminating the various defect problems like blow holes and porosity an At optimized parameters the casting quality can be better than the previous casting that was cast under the non-optimized conditions.

The outcomes of this review paper are very useful for finding solution for casting defects that occurs due to the incorrect process parameters in die casting. Also these results will help in improving the quality and productivity of die casting products.

I can also conclude that amalgamation of optimization techniques along with casting simulation works as a powerful tool for improving the productivity of the castings to a greater extent, in die casting industries.

The optimization procedure provide a decision tool for setting optimum parameters so that the defects taking place in the casting is reduced. From various paper it can be seen that the utilization of DOE methodology proved to be very efficient, in the analysis of this problem.

Along with optimization tool it is necessary to analyze the behavior of molten metal at differentstages of time by observing the results of temperature variations .For that at first stage any one can use 3D modeling software like Pro.E, creo etc After that Analysis software Ansys ,.Fluent, ProCast or any other software can be used to analyze the behavior of molten metal at different stages of time by observing the results of temperature variations, pressure variations and liquid fractions

Various tool and techniques like back propagation Artificial Neural Network (ANN), regression analysiswith software like Minitab , GRNN predictive model etc are used in various paper along Taguchi method and other optimization techniques for improving quality and productivity in die casting process.

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