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Analysis and Optimization of Ball Valve for Reengineering

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ABSTRACT

With the change economic scenario, the various factors are affecting the growth and survival of industry in India due to customer expectation and changes industrial processes/product were incapable of meeting today's stringent customer demand for quality, reliability, cost, and timeliness. "Reengineering is the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service, and speed". Due todimension of an existing valve body for reduction in weight. Also study of other parts manufacturing process method is require to develop by studying the existing processes for identifying the reengineering issue for improvement by quality, cost and design Comparing the result of analysis and optimize it with.
In this paper consists of a case study conducted at Ball Valve manufacturing industry, Thane, an attempt is made in existing products technical specification, weight, cost and quality.
increasing global and competitive environment reengineering being actively pursued by industries modeling and analysis of existing valve body.
principal, working and function of valve. After studying the existing system and comparing with some theoretical We developed a Finite Element Model using computer aided design and engineering software (Pro/ENGINEER).Then the finite element analysis, simulation software (ANSYS/FEM) is use for determine to finalization of critical

Introduction

The changing need and ever growing expectations of information rich customers, fast growing domestic competition, entry of several multi nationals in the country, Government thrust on experts and globalization of economy, fast change and easy availability of technology has forced, top management of Indian industries to look out for a new strategy [2]With the increased competition and turbulent business scenario, market leadership is also dynamic. The leader today may be the loser tomorrow with other company taking away the leadership this new leader company may not even exist today. To attain leadership and even survival in the market companies will have to go with the pace defined by the market, which depends, along with other business factors on the customer. So the company needs to increase the total value of the product whileCompanies Havereengineered manufacturing processes that were ill-conceived, poorly product and process designed, and outdated. These processes were incapable of meeting today's stringent customer demand for quality, reliability, cost, and timeliness. [3]
In order to satisfy the need of costumers and new challenges and improve the market dominate consultants have restored the variety of approaches such as redesign product and processes by using some software With this motive in mind under take this case study reengineers the product design and core processes of a valve company. Under this study is reducing weight of valve body for reduction of overall cost, improvement inquality and design of ball valve without sacrificing the basic principal, working and function of valve. In response fulfill the costumers increasing demand low cost, improved quality and reliability. Michael Hammer and campy gave the definition of reengineering as "Reengineering is the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service, and speed" [1]

John C. Coulson, Tomas [3] The application of technology and management science to the modification of existing systems, organizations, processes, and products in order to make them

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more effective, efficient, and responsive. Responsiveness is a critical need for organizations in industry and elsewhere.

Reengineered can be either one the following.

1. Product
2. Process
3. System management
4. Some appropriate combination of above

Product reengineering

In this contest this term reengineering could be interpreted as some kind of reworking product, which could simply be described as maintenance or refurbishment, father maintenance can be viewed from different perspectives; interactive or adaptive or perfective. Alternatively reengineering may also be interpreted as reverse engineering in which the characteristics of an existing product are highlighted for the purpose of modifying of reusing the product these notions contains two important reengineering facts.

1. Improvement of the delivered system/ product with respects to reliability and safety or satisfying system / product evolving user requirements, and

2. Improvement in the understanding of the system/ product this interpreting of reengineering is basically product focused; thus we call it product reengineering.

Hence product reengineering may be described as the examination, study and modification of the internal / mechanisms or functionality of an already developed product for the purpose of reconstituting it in a modern form with modern desirable features.The action such as this is often taken to
benefit from newly emerged technologies
but without making to product purpose and
the Modernization, retrofit, repair, renewal, redevelopment and so onPart list of ball valve

A case study

"SHRADDHA POLYMER INDUSTRY" M.I.D.C, Thane

Manufacture the piping items and valves required for process industries .The Company in this field is since last fifteen year. It has a wide range of products in valves and pipefitting. The valves manufactured by them are Ball valve, Diaphragm valve, Plug valves.

Ball valve being the most selling valve among the all products, it always needs the attention from the manufacturing point of view as well as end-users (customers) feed back for performance.

The design is being used for more than ten year, hence the existing design, process and other parameter like cost and marketing are required to be considered to achieve major gain in cost, service, or time hence need reengineering. An Engineering system process to transform an existing system into a new form.

An attempt is made in this case study to Ball Valve development under reengineering. After study of existing product and processes exploring the area of improvement by cost,

Developed a Model of ball valve using software (pro/ENGINEER). And analysis by ANSYS, confirmation of new design for final conclusion without spoiling the basic principal of working and function of valve are integral components in piping systems they are the primary method of controlling the flow, pressure and direction of the fluid.

To provide the maximum rigidity with minimum weight is important as per the function of valve. As Valve being the most critical component for any fluid handling processindustry. Hence it needs to be attended as a critical component of fluid handling system.

Therefore the design as well as the development of valve carries more importance compare to any other item.

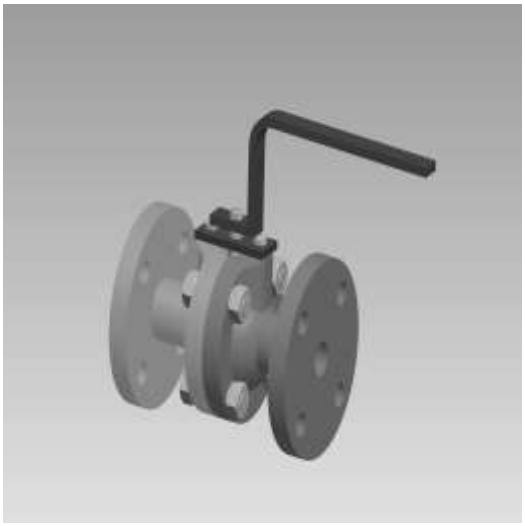

Fig.1

TABLE 2

Size	A OD	B ID	C	D	tf	F	G	t	Wt KG
25	115	29	99	45	15.5	18	45.5	8.5.	3
140	150	41	129	64	17.5	20	56	7.5	4
50	165	50	144	74	17	19	68	9	11

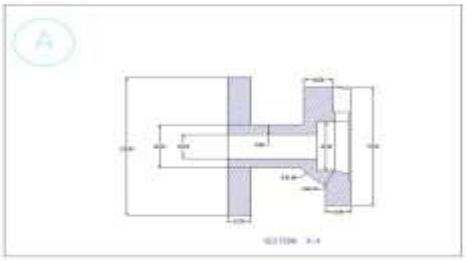

Fig:Existing Data OF Ball Valve Body (one part)
(See Fig. no. A)

Theoretical calculation
As per existing dimension of ball valve –
A) Valve body
1) Design of minimum valve body thickness (t)

1) Design of minimum valve body thickness (t)
Assumption:- Allowable tensile stress for cast iron (σt) = 14 N/mm²Corrosive allowance (C.A.) = 3 t = 6.11mm ≃ 6.5 mm
2) Design of flange thickness (tf) and outer diameter (Do)
tf = = 12.75 mm ≃13 mm Outside diameter of the flange
A (oD) =116mm Pitch circle diameter of stud (Dp) = 96mm

IV Modeling, analysis and optimization

As per consideration valve body is more critical part of ball valve First Finite Element Model is developed using computer aided design and engineering software (Pro /NGINEER for Modeling). Then the finite element analysis software (ANSYS) is use for determine to finalization of critical dimension of anxisting valve body for reduction in weight, cost and improvement in quality. Modeling of ball valve body (Using Pro / ENGINEER wildfire 3.0 design soft ware)

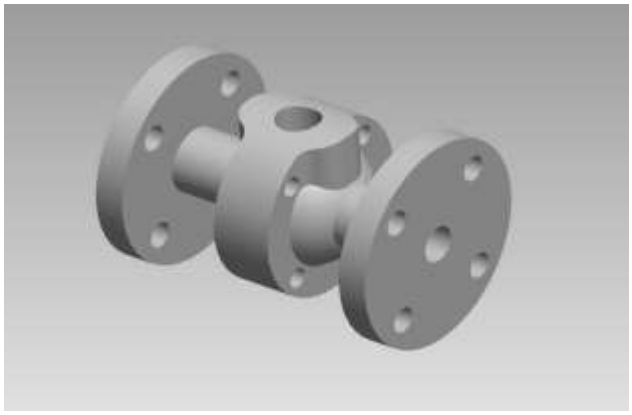

Fig.3

Export design of valve body through neutral interface (Like IGES, Parasoloid etc.) To ANSYS

Introduction of FEA & ANSYS Finite Element analysis, the core of computer Aided Engineering dictates the modern mechanical industry and play a decisive role in cost cutting technology.The finite element model, which has a finite number of unknown, can only approximate the response of the physical system, which has infinite unknowns. It depends entirely on what you are simulating and the tools you use for the simulation. ANSYS the leading simulation software, with its robust capabilities guides the engineers to arrive at a perfect design solution.It is used by engineer's world wide in virtually all fields of engineering; structural, Thermal, Fluid and Low Frequency Electromagnetic. ANSYS Multiphysics is the flagship ANSYA product which includes all capabilities in all engineering disciplines.

This software works in three parts Preprocessing, Processing,Post rocessing a) PreprocessingCreate the solid modelCreate the FEA Model Import solid model to ANSYS 8.0.While importing only surfaces are brought check the geometry for data loss and scaling of geometry to exact scale in mm then volume is created in the ANSYS Structural environment. Structural environment: - Define all physical properties Preprocessing > Element typeThe structural element soiled 187 is selected (fig no.4)

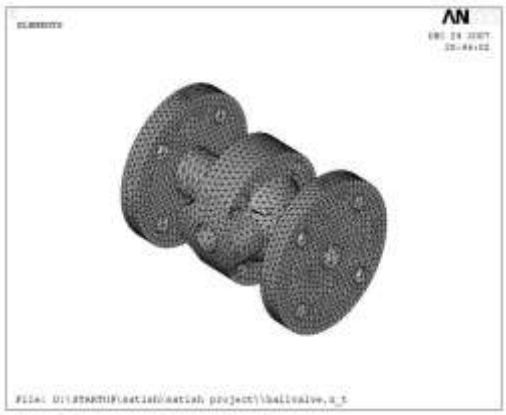

Fig.4

Fig.5

Define material properties Specify material, material properties, boundary conditions and other features that are used to represent the physical system to be applied on FEM. Preprocessing > Material properties > Material Model > Linear > Elastic > Isotropic
d) Mapping of von stress distribution of the valve. The structural environment is now fully described and hence saved. **).**
b) Processing /solution
Solution> Physics> Environment >Read> Structural> OK
For analysis select a solver to solve the Finite Element problem by applying Degree of freedom (DOF) Constraints, Concentrated loads Post, surface loads Load distribution over a surface, such as pressures or convection, body load, inertia loads. Different pressure applied –on the FEM. model Check stress distribution of the valve under different pressure/ load apply constraints we consider only internal presses we are not consider so we will not get the result in terms of stress development and deformation on critical part.

Post processing – Review results

Post processing is the final step in the finite element analysis process.

Postprocessor>plot,Results>stresses deformation

Results can visualize what's actually happening to a valve body at various pressure/load and temperature by produces an animation to the 3D model and the different result can be observed like internal stress distribution and deformation across the valve body

By identification of critical area increase the thickness of valve body where extra strength is needed and to reduce the thickness from lower pressure areas where it isn't required

And check the strength of valve by considering the factor of safety and repeat

- the FEA process for different dimension and finalized the dimension of valve body
- Optimize strength, by considering all factors for reduction of a valve body the weight.
- The result of the analysis and optimization are read & interpreted.

It is presented in the form of a table and plotting various comparative charts with existing ball valve specification in terms of weight and cost reduction reduce weight of valve body for reduce the overall cost, improvement in quality and design of ball valve without sacrificing the basic principal, working and function of valve. Now it is observe that there is scope in thickness reduction in some region of valve bodyby

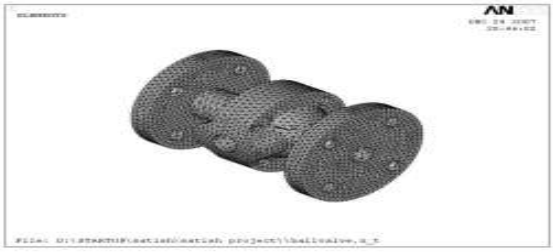

Fig.6

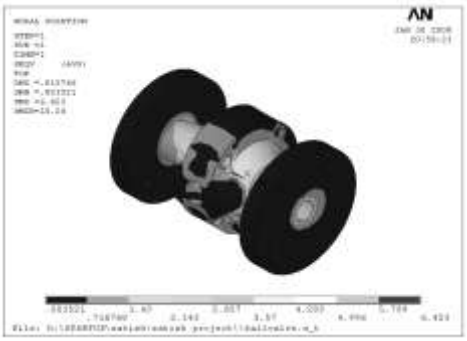

Fig.7

If we consider the 3D model one part of valve body, sectional view of valve body as per existing dimension and required dimension having variation in some region .Out of these some are more critical but in some region there is chances of reduction of thickness with out any effect over the valve body by applying DOF constraints, Load and different pressure over valve body it will be possible to reduce the thickness of point which is having a excess and also check the effect at critical point By doing this activity if the overall weight will be reduceby 15% so the cost also reduces in the ratio of weight.

Comparison with existing data –

1- Effect on critical dimension /region of valve body for finalization of, and reduction of thicknesses dimension by consideration of different value of pressure, DOF constraints, number to operation required for manufacturing so it also required some changes in term of manufacturing processes, design & operation by which overall cost of production will be reduce . After studying the existing operation carried for manufacturing it observed that the Handle and Ball is more time consuming part as concern of

Statistical calculation— (by assuming the weight reduction in valve body)

For eg. Weight of 2.5" (65 NB) ball valve body is 10 Kg. it will reduce by 15% it 1.5 kg reductions in weight and cost of 1kg C.I. 65 Rs to 75 Rs.. So for one valve body cost will reduce up to 112.5 Rs. If the requirement is of 100 valve body then 100 x112.5 =11250Rs

Conclusion

--AS per consideration and comparison with theoretical calculation of exiting valve body over all thickness is excess (Table no2.) so the overall reduction in weight.occuredby comparing all result with existing product/ system and gets the improvement in valve by quality, cost and design. is the cost reduction only in valve body.

.2 Further scopes in some modification of design and manufacturing process in other parts of valve like- Handle and Ball

	Critical dimension /region								
SIZE 25	Pressuer /load	Flange E 1	Flange F 2	Flange G 3	Thk I 4	DIAI J 5	6		
		15.5	**16**	**18**	**8.5**	**48**	**8**		
	5	**X**	**X**	**X**	**X**	**X**	**X**		
	10	**X**	**X**	**X**	**X**	**X**	**X**		
	15	**X**	**X**	**X**	**X**	**X**	**X**		
	20	**X**	**x**	**X**	√	√	√		

X—No effect of presser and other contains /Critical dim. √-- Effect of presser and other contains /Critical dim.On point's (region 1, 2, 3,) having excesses thicknesses observed as compare with actual and calculated and we can also find out with help of software ANSYS/FEA by applying different pressure uses load and finalize the dimension of valve body out the reduction of dimension/over all weight of body.

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