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Investigation of Valve by Value Engineering for Sustainability

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Abstract: *The change observed in the Industrial environment is a consistent process. The changes observed in the product in comparison to earlier design is so faster and difficult to predict its presence. The rate of change of any product has become so faster due to customer's demand. The manufacturing enterprises are constantly practicing to innovate and improve the design of product and process operations for sustainability and cost effectiveness. This product sustainability and cost effectiveness aspects can be achieved by investigating the specific product by value engineering for enhance the productivity. This will help to maintain their margin and competitive advantage of the product. In this research work, the scholar has undertaken a problem of valve manufacturing industry as a real time problem to investigate it through value engineering by comparative study of valves in various manufacturing industry to analyze the performance in context to sustainability and cost effectiveness. This will help the scholar to suggest the re-design and modification by value engineering of the product. This is the prime focus of this research work.*

Keyword: *Competitive advantages, Cost Effectiveness, Sustainability, Value Engineering Abstract*

I. INTRODUCTION

Value engineering is the systematic application of recognized technique which is identified the function of the product or service, establish a monitory value for that function and provide the necessary function reliability at the lowest cost. The Purpose of Value Engineering systematic Approach is to provide each individual with a mean of skilfully, deliberately and systematically analysis and development of alternative means of achieving the function that are desired and required.Today, the manufacturing enterprises are focusing their more attention on competitive advantage, reconsideration of technology management, as well as redesign and process engineering to make the product more sustainable and cost effective. In view of above, the research Woke has undertaken a problem of valve manufacturing industry as a real time problem to investigate it through value Engineering and try to suggest the modification in the design as well as process engineering of valve in this research work for the sustainability and cost effectiveness. The change observed in the Industrial environment is a consistent process. The changes observed in the product in comparison to earlier design is so faster and difficult to predict its presence. The rate of change of any product has become so faster due to customer's demand. The life style and culture is also very much responsible for changing the product design. Rapidly growing population and globalisation is one of the factors responsible to the change. Largely changing customer demands and variety of expectation add to the changing environment. There is a continuous development in the technologies observed parallelly. The investigation of such product can be made through value engineering a systematic approach to analysing functional requirement of product for the purpose of achieving the essential function at lower cost.

II. Literature Review

Bhosale Abhijeet T. [1] analyzed Butterfly valve disc by FEA analysis of Butterfly valve body and weight optimization. The weight reduction is done by changing the disc thickness. With the help of different optimization models created by changing the parameter and analyzed. Results are shows that the maximum weight reduction in different section is 2 Kg while keeping maximum stress level up to 140N/mm2 which is safe for the applied load.

B.Rajkumar [2] explained the typical problems faced in the industry with the conventional globe such as the difficult manual operation due to higher valve torque, stem bending issues in stainless steel material, packing performance deterioration by rotating stem design, galling problems at stem threads and at flange bolts and gland packing eyebolts at low temperature. FEA and CFD tools are used to optimize the body-bonnet cover flange thickness, disc thickness and flow geometry. Shows how FEA and CFD tools are used to effectively optimize the valve design.

Chougule Mahadeo Annappa [3] presented the basic fundamental of value engineering that can be implemented in any product to optimize its value. In this case study of a Universal Testing Machine (UTM) he discussed in which the material, design of components is changed according to the value engineering methodology.

For reduction of cost he selected some components from Universal Testing Machine and he applied value engineering technique for the cost reduction of these components of Universal Testing Machine.

Chern Ming-Jyh. [4] Studied experimentally the performance, flow patterns and cavitations' phenomena of a ball valve. Various patterns of flows in and downstream the ball valves with respect to different valve openings and inlet velocities are visualized using a particle tracking flow visualization method (PTFV).

Gurav Shridhar S.[5] In this Literature review of valve work done by different researches in the area of weight optimization and experimental stress analysis technique the result of each one showing that classical and analytical results are approximately matches with each other and that can be used for further development of the gate valve. Now a day's everywhere Optimization concept is in the focus, no doubt its fruit of the cost cutting concept.

Dr. K.H Jathar & sunil S. Dhawn [6] has worked on classical theory and finite element analysis of the gate valve. Finite element analysis carried out by using Ansys software. Stress value of classical and finite element analysis compound and it matches approximate with each other. And that can be used for further development of gate valve.

Sharma Amit [7]. Studied the best feasible solution from the available alternatives is chosen through the feasibility ranking table. Through the application of Value Engineering profits are maximized without hindering the reliability of the product. With the effective utilization of the Value Engineering technique the various advantages have been observed in terms of cost reduction, increase in overall production, reduction in manpower, and reduction in scrap these outcomes to be a successful showcase of value engineering.

Sharma Amit [8] presented the basics of value engineering and its different phases that can be implemented to a product for its optimization. Value engineering can improve the product cost by reducing unnecessary cost associated with the product. It explores each part of the value engineering job for successful application of the technique. In A case study he has been discussed and analysis has been carried out by the process to achieve the product optimization. The results obtained after implementation of various techniques is cost of product minimize and quality of product improves.

Sturges Robert H [9] stated that the Value Engineering techniques based on function have been the means to improved products and processes for several decades. It is a social design methodology that is usually episodic in application and often confused with narrow interests, such as cost cutting. He conclude that VE is neither a different nor a sufficient way to design compared with more conventional analytical and synthesis techniques. It is rather a parallel and necessary process with different inputs and outputs

Jadhav Shashank S. [10] it is stated that the optimum thickness design required for the Gate valve for functioning smoothly under high pressure. Author proposed the method to study the pressure valve is the device that is used to channel high pressure fluid and control the flow of the fluid through a pipe. Thus the requirement of the gate valves in petroleum industry is high thus the reduction of the thickness of the valve to an optimum thickness will reduce the weight and cost of the valve. In this paper he deals with the optimum thickness design required for the Gate valve for functioning smoothly under high pressure.

Kim Jun-Oh [11] in this paper the author explained the butterfly valve shape design process. Author analyzed the butterfly valve shape design process using Taguchi method, and thus becoming more successful topology optimization, the sensitivity region becomes larger. In designing a double-eccentric butterfly valve, related to hydrodynamic performance and disc structure, are discussed where the use of topology optimization has proven to dramatically improve an existing design and significantly decrease the development time of a shape design.

Xue-Guan,Seung-Gyu [12] In this paper the author Studied the mechanical and chemical properties of CF8M through experiments .Proposed model of CF8M stainless steel ball valve to enhance general corrosion resistance and to provide good strength by performing studied through experiments an application of CF8M in valve body was analyzed by using finite element method (FEM) to evaluate the structural safety . An optimization counting several variables based on the response surface method (RSM) was conducted to find the optimum dimension of the valve. The result show the using this process can save valve mass as well as the computational expense effectively

Pavel Macura [13] author worked on experimental analysis of residual stress on concrete part of pipeline welded ball valve .strain gage technique used for measurement of residual stress both immediately after welding and after pressuring of the valve. They have used especially rectangular strain gauge in the form of rosettes with 1.5mm length. Cylindrical holes were drilled stress of these rosettes successfully in six depth for measurement of released relative strain. Result of realized measurement serve as basis for evolution of strength life of this component.

G. Gokilakrisnan [14] author studied how the basics of operating torque required for ball valve. If the ball valve required more torque thane required minimum torque during its operation, manual handling will be very tough. To reduce the manual effort and eliminate the use of external device which is also effect on selection of actuator.

It is revealed from the literature review that many researchers have been carried out an effective work on re-design and process engineering of products. By using Analysis tools and Design of Experiments. So these tools are appropriate to fulfill the value engineering approach. There are quite a few researchers have put forth variety of methodologies for process engineering. Every product design and process engineering is unique, the resources, controllable factors, un-controllable factors, and constraints being different. The structured approach for re-design of product and process engineering may change the conventional methodology and achieve the enhancement by value engineering.

A CASE STUDY

In this research work the identified product for the purpose of investigation is Valve by value engineering for sustainability. Valves are integral components in piping systems and uses for the various purposes. It is used as the prime device for controlling the flow, pressure and direction of the fluid flow. In engineering and chemical industries there are 20-40% piping installed for fluid handling. As the Valve is the most critical component for any fluid handling process industry, it needs to be attended as a critical component of fluid handling system. The identified industry has a clear and precise mission to achieve the highest level of excellence that will keep getting better and better and eventuate into a benchmark of the industry.

The identified valve manufacturing enterprise is facing a problem of 10 to 15% cost escalation for the production of valves as compared with the other competitors from last two years. However, the industry was in profit since its inceptions year 1984. This has resulted in a loss of profitability and decreased return on investment to the concerned therefore the question arises about it sustainability and cost effectiveness. It is observed from the initial data that the overall cost of the valve is more as compared to the competitors due to Weight of the existing valve is more which affects the overall cost. Manufacturing process of valve is as per conventional Job work. There is no defined cycle time for process. Proper approach of Value Engineering is not followed. Looking into these difficulties, the research problem can be defined as to investigation of valve by value engineering point of view for its sustainability.

In this research work, undertaken a comparative study of valves in various manufacturing industry to analyze the performance in context to sustainability and cost effectiveness. To analyze the same, data from various valves manufacturer and their customer's has gathered about the performance and cost of the valves. This will help to suggest the re-design and modification by value engineering of the product.

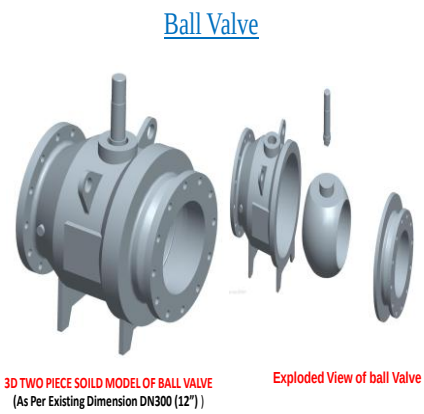
The main objective of this research work is to minimize the overall production cost, improvement in quality specifications and re-design of valve without minimizing the basic working and function as principle of valve. To fulfill the costumers increasing demand of low cost, improved in quality and reliability of the finished product resulted in sustainability and cost effectiveness of product. The following objectives will be focused in this research work to develop a various modules:

- To study the technical specification, critical dimension and manufacturing process of valve and its components.
- To make the comparative analysis of valves with respect to function and cost.
- The valves will be analyzed by using value engineering approach.
- Investigation in this regard will be carried out by using Analysis tools and Design of Experiments.

V. SCOPE OF RESEARCH WORK

The concerned industry is producing various valves like Globe control valve, High Performance Butterfly Valve; Manual operated Butterfly, Ball valve necessary for different process industries. It will not be possible to cover all the products in the research work. Hence the research work will be confined only on Ball Valve.

Table-1.Weight of Existing Ball valve Of Size 12" 150# Class



Sr. No	Part list	Cast 3d	Finsh-3D
1	Body	221.34	189
2	Side conn	127	90.63
3	Ball	195	153.74
3	Seat Retainer (2 Nos.)	39.28	21.6
4	Trunnion (2 Nos.)	31	22
5	Bonnet	10	5.68
6	Mounting	20	14.26
7	shaft	8.13	5.15
8	Other Parts	10	10
9	Total Wt. (Body set.)	662.25	512.06
10	Target wt.		367
11	Body set		309.57

Fig1 .Ball valve As per Existing Dimension

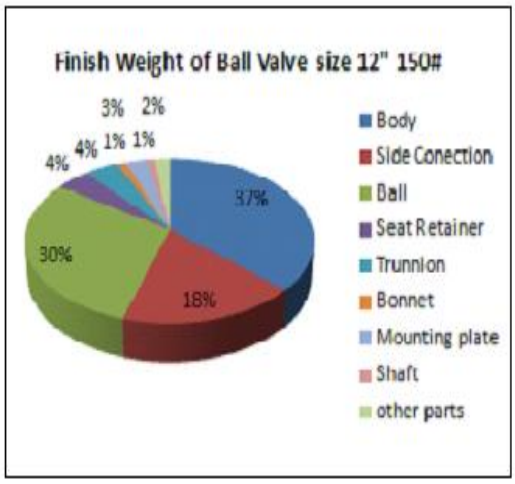


Chart no1:- charts showing the weight of valve

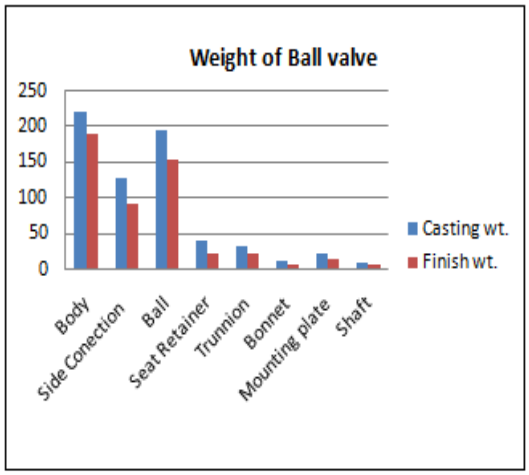


Chart no2:- charts showing the weight Of Ball valve

Overall cost of valve mainly depends on three factors. First factor is weight of valve body, Generally Ball valves are manufactured by casting method. Ball valve Body and side connection contributes considerable amount of weight in assembly (about 30% to 40% of the total weight). So for optimization of ball valve body it is necessary to get the tensile stress pattern of the body, which is possible by using Finite Element Analysis . Second, operating torque of valve by reducing operating torque proper selection of actuator if the ball valve required more torque then required minimum torque during its operation, manual handling will be very tough. To reduce the manual effort and eliminate the use of external device which is also affecting on selection of actuator it will affect on reduction of cost for actuator. Third factor manufacturing cost of valve by reducing cycle time manufacturing process of ball valve for defined the cycle time of assembly. By proper optimizing these factors we can reduced overall cost of ball valve and profitability will increase as compared with the other competitors and it will sustain in the market.

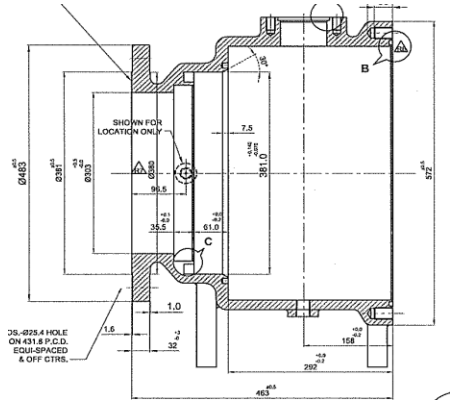


Fig.2 valve body before Modification

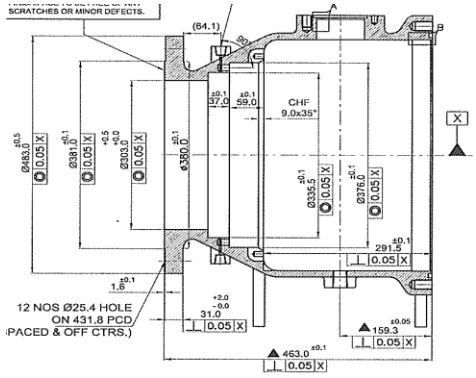


Fig3.valve body After Modification

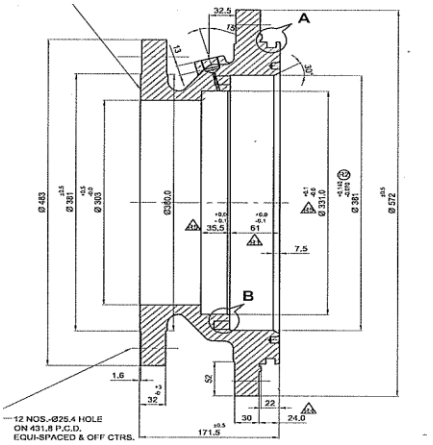


Fig4. Side connection Before Modification

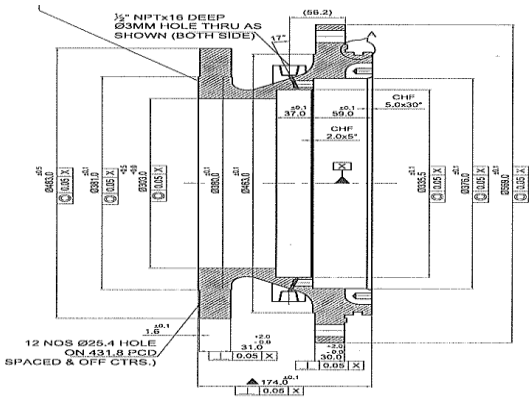


Fig5 Side connection After Modification

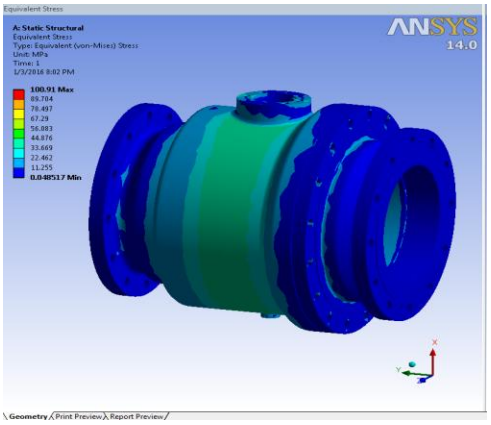


Fig6.Stress distribution in valve after Modification

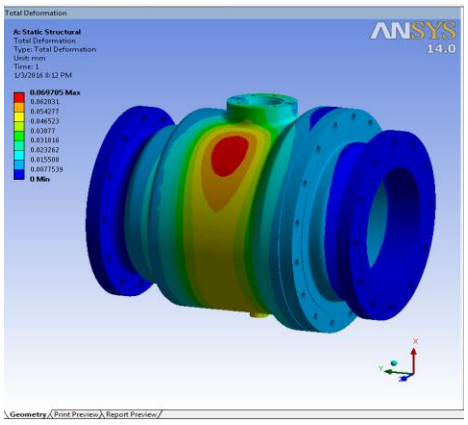


Fig7.Deformation in valve after Modification

Table No.2 summarized result 0f ball Valve part list as per

Sr. No.	Part list	Before Modification	After Modification
1	Body	189	141
2	Side connection	90.63	83
3	Ball	153.74	148.3
5	Trunnion (2 Nos.)	22	20
6	Bonnet	5.68	5.43
7	Mounting	14.26	14.26
8	shaft	5.15	5.12
9	Other Parts	22	20
Total weight		490.46	391.02

Table No.3 Summarized result of ball Valve weight before and after modification

Sr. No.	Part Name	Weight before modification (Kg)	Weight after modification(Kg)	Von Mises stress (N/mm^2)
1	Body	189	141.8	100.9
2	Side Connection	90.63	83.18	14.3

VI. Conclusion

As per Literature review of valve work done by different researcher in the area of weight optimization of valve by using value engineering approach Investigation of valve in this regard carried out by using Analysis tools and Design of Experiments. Result each one showing classical and analytical results are approximate matches with each other and that can be used for further development of valve.

In this paper an attempt has been made for overall weight optimization of ball valve by modification of dimension. As per the standard diamentions , ball valve has been modifiied and the thickness of the ball valve parts from calculations is less than the actual design in use. Weight of valve body and side connection is reduced as per the result of analysis and optimization results are approximately same with as per modification in dimension of valve. Due to the reduction in weight of valve body and side connection cost of valve has been reduce as first part of this work and overall cost of valve will be reduce by reuducing weight of other parts of valve, cycle time of manfcturing process and cost of actuator by reducing the torque of valve.

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