Weight Optimization of Valve by Value Engineering for Sustainability

[1]Satish M. Silaskar
Research Scholar, Mechanical Engineering, Datta Meghe College of Engineering, Airoli, Maharashtra India,
satishsilaskar@rediffmail.com

[2]Vilas B. Shinde
Principal, New Horizon Institute of Technology & Management, Thane, Maharashtra India,
vbs_life@rediffmail.com

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. The manufacturing enterprises are constantly practicing to innovate and improve the design of product by weight optimization and process operations for cost effectiveness and Sustainable. In this research work the identified product for the weight optimisation is Valve. Valves are integral components in piping systems and uses for the various purposes. The modification in valve can be made through analysing functional requirement of valve for the purpose of achieving the essential function at lower cost. Value engineering tools are primarily used to improve the value of the product and services and reduce the cost of the item giving a cost benefit which directly profits the bottom line of the organization.

Key word*: Weight Optimization, Sustainability, Cost Effectiveness, Value Engineering,*

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I. INTRODUCTION

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 weight optimization of valve. 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. Weight optimization is the process of modifying or changing an existing design in view of objective to improve few of the aspects. These aspects of an engineering design which concern are performance, manufacturing and assembly. Identified products weight is more as compare to other competitor's products, for reduction of weight redesign of product is required. With the help of Comparative study of various valves manufacturing industry to improve the quality, reliability and reduction of cost which fulfill the customers demand. So modification in design and standardization of the valves is required which can be termed as redesign of valve Due to redesign and standardization size of the valve will be reduced and it effects in weight reduction. Therefore, by weight reduction not only the material cost will be saved, but also the machining time and the cycle time will be reduced and the productivity will be increases and product will be sustained in the Market. Value Engineering methods are very important and useful in Cost Reduction and sustain their profitability. Value Engineering is the most under-utilized problem solving technique in existence today. It is also one of the most effective techniques available to identify and eliminate unnecessary costs in design, test, manufacturing, construction, operations, maintenance, data, software, procedures, specifications and practices. Although its application to procedures, specifications and practices is less well known, its effectiveness in these areas has been proven. value Engineering is an organized/systematic approach directed at analyzing the function of systems, equipment, facilities, services, and supplies for the purpose of achieving their essential functions at the lowest life-cycle cost consistent with required performance, reliability, quality, and safety[1] Society of Japanese Value Engineering defines VE as: "A systematic approach to analyzing functional requirements of products or services for the purposes of achieving the essential functions at the lowest total cost" [2].Value Engineering is an effective problem solving Technique. Value engineering is essentially a process which uses function analysis, team- work and creativity to improve value [3].

II.HISTORYAND GROWTH OF VALUE ENGINEERING

Value engineering began at the general Electric co. during World War II. Because of the war, there shortage of skilled labour and raw materials. Some critical materials were difficult to obtain, and a great many substitutions had to be made. The results of these changes were often lower costs

and improved products, as observed by Mr. Harry Erlicker, Vice President of Purchasing of General Electric Company. When the General Electric Company found that many of the substitutes were providing equal or better performance at less cost, it launched an effort (in 1947) to improve product efficiency by intentionally and systematically developing less costly alternatives. Lawrence D. Miles, a staff engineer for General Electric, led this effort. Miles combined a number of ideas and techniques to develop successful methodological approach for ensuring value in a product. [4] They noticed that the substitution often reduced costs, improved the product and in some cases, both. What started out as an experimental driven by necessity was turned into a system process. This methodology was original termed as "Value Analysis" As other adopted the technique, the name gradually changed to value engineering.

III.VARIOUS PHASES OF VE

The organized and systematic approach of Value Engineering Job Plan is the key to success in a value engineering study. It is through the job plan that the study identifies the key areas of unnecessary cost and seeks new and creative ways of performing the same function as the original part, process, or material. It works, and has been proven effective in manufacturing processes and procedures, and in the other field. The job plan allows the study team to go farther than the usual design process. Following are the phases of value engineering job plan:

A. Information Phase

In the information phase clearly identify the problem to be solved and gather the information on the background, function and requirement of product

B. Function Analysis Phase

'Function' can be defined, as the use demanded of a part of product and the esteem value that it provides. These functions therefore make the product work effectively or contribute to the 'saleability' of the product.

C. Creative Phase

This step requires a certain amount of creative thinking by the team. A technique that is useful for this type of analysis is brainstorming. This stage is concerned with developing alternative, more cost effective ways of achieving the basic function.

D. Evaluation Phase: In this phase screen the ideas developed during the creative phase. Ideas found to be irrelevant or not worthy of additional study are disregarded;

Those ideas that represent the greatest potential for cost savings and improvements are selected for development.

E .Development Phase

In the development phase, final recommendations are developed from the alternatives selected during the analysis phase. Detailed technical and economic testing is conducted and the probability of successful implementation is assessed

F. Presentation Phase

The presentation phase is actually presenting the best alternative (or alternatives) to those who have the authority to implement the proposed solutions that are acceptable. It includes preparing a formal VECP or value engineering proposal (VEP) that contains the information needed to reach decision and implement the proposal.

G. Implementation and Follow Up- During the implementation and follow-up phase, management must assure that approved recommendations are converted into actions.

IV.A CASE STUDY

In this research work the identified product for the purpose of weight optimization is Valve. 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 concerned industry is producing various valves like Globe control valve, High Performance Butterfly Valve; Manual operated Butterfly, Ball valve necessary for different process industries. Value Engineering is applied to the valve. The steps used for this purpose are as follows:-

1. Product selection plan: It will not be possible to cover all the products in the research work. Hence in the research work confined only on 12"-150 Class Ball Valve.

2. Gather information of product: 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. Overall costs of valve mainly depend on three factors. First factor is weight of valve body, Generally Ball valves are manufactured by casting method.

Ball Valve

3D TWO PIECE SOILD MODEL OF BALL VALVE
(As Per Existing Dimension DN300 (12"))

Exploded View of ball Valve

Fig1 .Ball valve As per Existing Dimension DN300

Table No.1 part list of ball Valve

SR NO	PART NAME	MATERIAL		QTY
		CARBON STEEL	STAINLESS STEEL	
1	VALVE BODY	ASTMA216-WCB	ASTMA351-CF8M	01
2	SIDE CONNECTION	ASTMA216-WCB	ASTMA351-CF8M	01
2	BALL	ASTMA105N/ENP	ASTMA182-F316	01
3	SEAT RETAINER	ASTMEA105N/ENP	ASTMEA182-F316	02
4	VALVE SHAFT	ASTMEA105N/ENP ,	ASTMEA182-F316	01
5	FASTENERS (NUT)	ASTMA193-B7	ASTMA193-B8	16
6	FASTENERS (Bolt)	Stainless steel	Stainless steel	16
7	O RING	VITON/NBR/EPDM	VITON/NBR/EPDM	08
8	GASKET	316SS+Graphite	316SS+Graphite	06

Chart no1:- Pie charts showing the various parts cost Of Ball valve

Ball valve Body 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.

3. Functional analysis: 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

4. Development Alternate Design or Method ; During brainstorming ideas Were Listed For Cost Reduction of ball valve, change design of ball valve, change material, change production process, Reduce torque

5. Evaluation Phase; for reduction of cost of valve as first ides weight of valve change by making some changes in existing design of ball valve

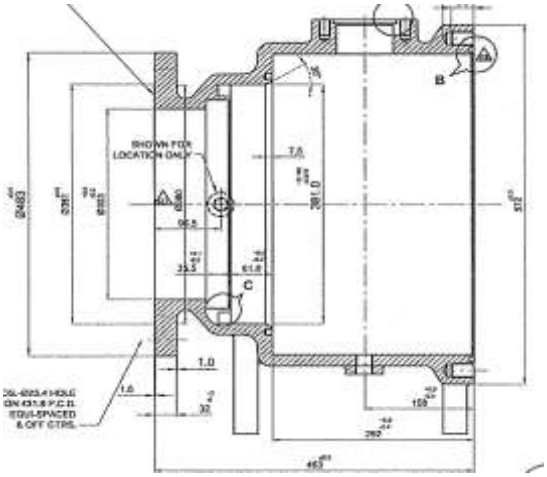

Fig.2 valve body before Modification

Modified the outer dimension and shape of valve body as shown in fig, 3 which effect on wall thickness which is reduce from 36mm to 26mm.

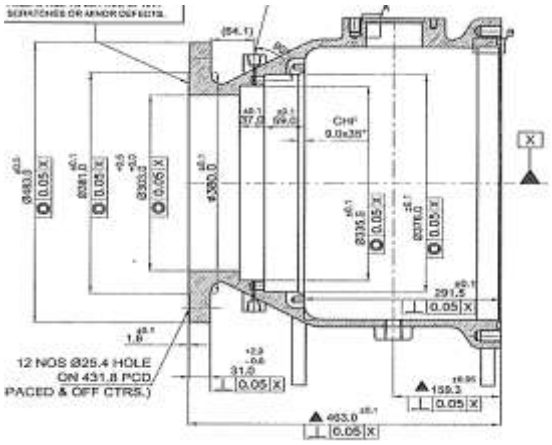

Fig3.valve body After Modification

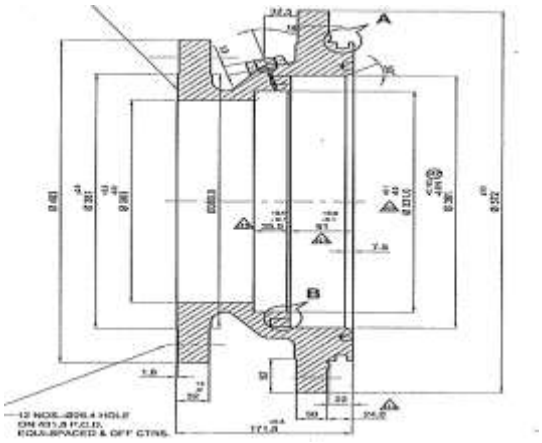

Fig4.SideconnectionBeforeModification

Modified the outer dimension and shape of side connection as shown in fig, 5 Reduced outer distance from 571 to 569which effect on wall thickness of flang.

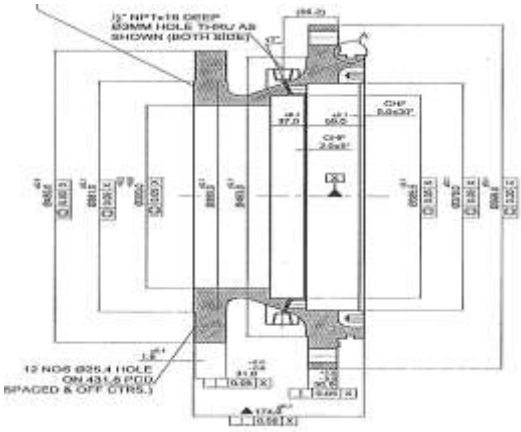

Fig.5.Sideconnectionafter Modification

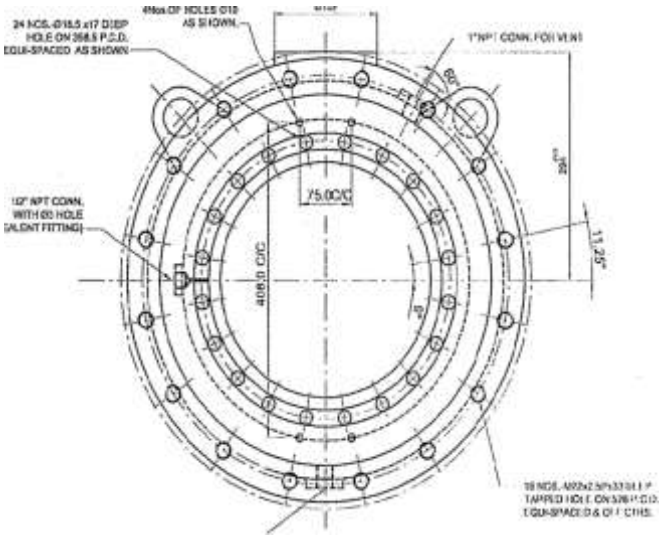

Fig.6 valve body before Modification

Other Modification in valve body as shown in fig.7 are i) Create slot at the place of Ball rest (trunnion) for weight reduction .ii) Reduced hole at seat retainer from 24 No. hole to 16 No. Holes which reduced the drilling time and also effect on torque. iii) Add the padding and support stand as cast in modified valve.

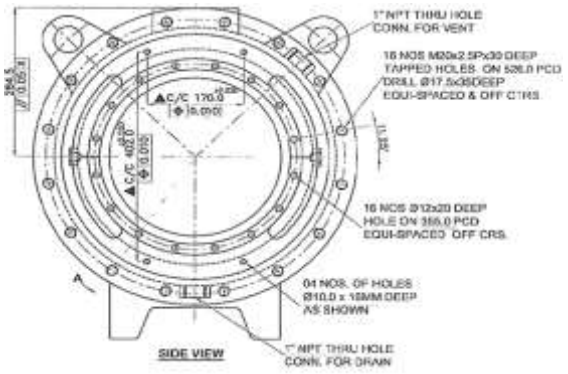

Fig.7 valve body After Modification

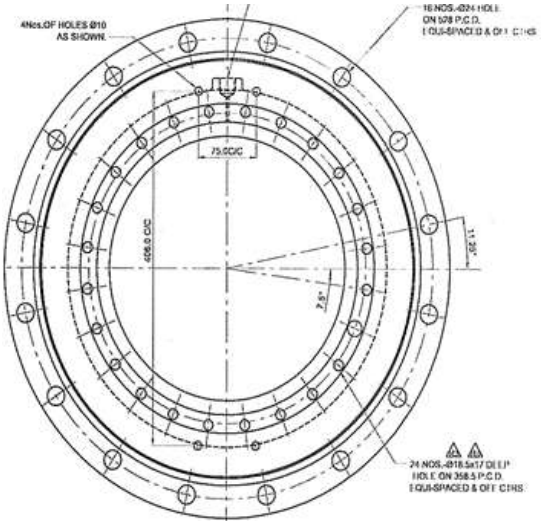

Fig8.Sideconnection before Modification

Modified in side connection as shown in fig, 9 are i) Create slot at the place of Ball rest (trunnion) for weight reduction ii) Reduced hole at seat retainer from 24 No. hole to 16 No. Holes which reduced the drilling time and also effect on torque.

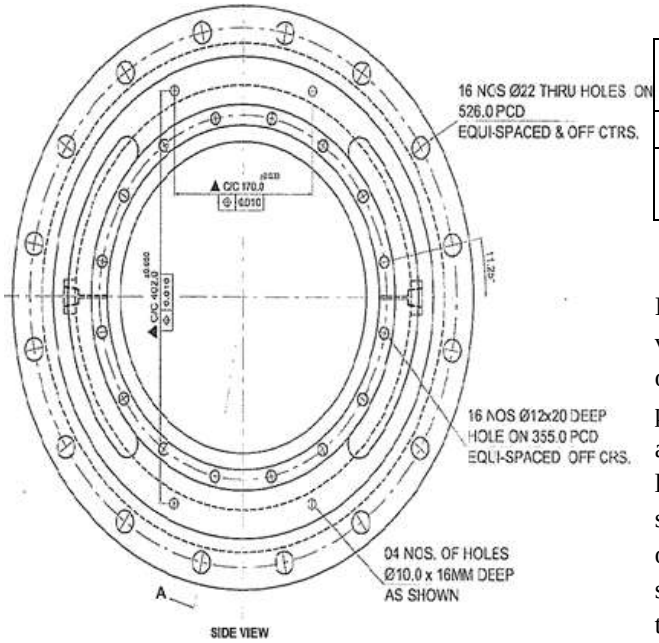

Fig.9.Sideconnection after Modification

Fig.10.Sideconnection after Modification

Fig.11. Valve body and Side Connection after Modification

Table No.2 Summarized result of ball Valve part

Sr. No.	Part list	As per cast Before Modification	As per cast After Modification
1	Body	240	218
2	Side connection	129	121

V. CONCLUSION

In this paper discussed above we have used the concept of value engineering to optimization the overall weight optimization of ball valve by modification of dimension. As per the standard dimensions, ball valve has been modified 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 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 reducing weight of other parts of valve, cycle time of manufacturing process .

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