Review on HDPE Fuel Tank for Maruti Alto Car as an Alternative

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Abstract

Conventionally metal has be used extensively for manufacture of almost all the part of the vehicle but of late the Equipment manufacturers for looking for alternate viable options specifically plastic against metal which would improve the performance criteria due to reduced weight and cost. This insight along with the changes in legislation has forced the Original Equipment manufacturer to look for the other viable options. The metal fuel tank has been a mainstay for auto manufacturers but its weight, cost; life is comparatively at a higher side as compared to plastic for same specification. The drivers for a material change are legislation, increased required part life, permeability, weight, packaging, safety, and cost. In this paper we try to review the performance attribute of plastic and metal from the manufacturer's perspective in the critical areas of manufacturability, cost, design, weight, safety, corrosion, and recyclability. This article compares metal and plastic for fuel tank uses according to performance attributes such as weight, strength, permeability, manufacturability and cost. This study is expected to provide a good insight to the manufacturer of fuel tanks, in regards to advantages and disadvantages of plastic and metal fuel tanks.
Keywords: Metal fuel tank, plastic fuel tank, automotive industry

I. INTRODUCTION

Plastic fuel tanks are being replaced increasingly in place of steel tanks have been used in recent years due to their several advantageous properties such as their light weight, low material and production costs, high safety levels, greater capacity due to greater choice of shape, non-corrosiveness property and good design flexibility. In 1972, VW Passat cars rolled out car with plastic fuel tank as a mass production. Since then the major automobile manufacturers around the world have started to show interest in and to work on the use of the plastic fuel tanks.

Many researches have been carried in the domain of car fuel tank. Fuel permeation mechanism was defined and multilayer fuel tanks' structural features and the development of resins. The properties, advantages and disadvantages of high capacity plastic fuel tanks of trucks were investigated. Researchers found that, because of the high levels of sulfur in the content of fuel sold in many countries, corrosion could occurred inside the steel fuel tanks and, the fuel caused some damages to the engine injection system. After examining several alternative materials in terms of certain features such as cost, safety, recycling, replacement and compatibility, they came up with the solution that the fuel tanks should be manufactured using polyethylene material

II. LITERATURE REVIEW

1) Hiroaki Himeki[1], Hiroshi Kumagai[2] and Katsumi Morohoshi[3] –The fatigue behavior of the high-density polyethylene applied to fuel tanks was analyzed under the low-level cyclic loading that simulated fuel tank pressure changes. The correlation between fatigue life and stress, temperature and frequency (the major influencing factors) was expressed quantitatively using fatigue test data for test pieces. This formulation was then verified in fatigue tests conducted on plastic fuel tanks. The validity of this equation for predicting the fatigue life of plastic fuel tanks was thus confirmed.
2) Pierre Delbarre[1] and Antonio Rod Barrier[2] –Barrier Technologies Applied to Plastic Fuel Tanks Comparison of Their Performance, by Delbarre. P and Rod. A. Their low density, to their excellent process ability and recyclability, and to their outstanding chemical resistance and specific mechanical strength, polymers are now the best materials to be applied in fuel tank systems. In that field, High Density Polyethylene is regarded as the best compromise between economical and technical requirements. But, basically, because of its chemical nature and structure, HDPE offers a poor barrier to hydrocarbons, especially light ones composing gasoline. Then, in order to meet to more and more demanding regulations on air quality and emissions, professionals from the Fuel Tank System area have developed several technologies in order to cope with that property of HDPE
3) Pravin-Rakheja[1], S, Sankar[2] and Ranganathan[3] –Influence of Tank Design Factors on the Rollover Threshold of the Partially Filled Tank Vehicles by Rakheja.S, Sankar.S and Ranganathan. R. This paper gives a brief description on general purpose tank vehicles often carry partial loads in view of variations in the weight density of the liquid cargo and are thus subject to slosh loads during highway man oeuvres.

4) James I. Changa[1] and Cheng-Chung Linb[2] –They reviews 242 accidents of storage tanks that occurred in industrial facilities over last 40 years. Fishbone Diagram is applied to analyze the causes that lead to accidents. Corrective actions are also provided to help operating engineers handling similar situations in the future. The results show that 74% of accidents occurred in petroleum refineries, oil terminals or storage. Fire and explosion account for 85% of the accidents. There were 80 accidents (33%) caused by lightning and 72 (30%) caused by human errors including poor operations and maintenance. Other causes were equipment failure, sabotage, crack and rupture, leak and line rupture, static electricity, open flames etc. Most of those accidents would have been avoided if better engineering have been practiced
5) Jones, T[1] and Matkovich[2] - This paper defines the geometry of minimum weight tank structures of giving the enclosed volume. A tank structure is seen to comprise a circular cylindrical shell (monologue or stiffened), bulkheads, and skirt structures. The analyses, starting from established criteria of failure, apply to the loading cases of longitudinal compression and bending moments in combination with internal pressure. The bulkhead geometries are flat, hemispherical, and ellipsoidal. For monologue shells, the analyses yield the radius and wall thicknesses prescribing a minimum total weight of cylindrical tank wall, bulkheads, and skirts (unpressurized cylindrical appendages, for example, interstate structure). For stiffened shells, the analyses yield the tank radius, skin gauge, stringer spacing, and frame spacing prescribing a minimum total tank weight.

III. IDENTIFIED GAPS IN LITERATURE

In most of the recent published work has focused on fuel tank in perspective of vibration, Heat and Stress Analysis. Work limited to fuel tank production technique has not been dealt with till now so in this work we intend to propose and present an efficient and economical method of production . The proposed work is expected to serve as a catalyst in improving the production and with reduced weight and cost it is expected to bring a sea change in the way the automobile are being manufactured.

IV. PROBLEM FORMULATION

A pressure strength test is employed to check that for a maximum allowable pressure the tank under consideration does not leaks out or undergoes deformation which will seriously hamper the performance of the vehicle. The level of pressure to be applied should be determined on the basis of the geometrical and material characteristics measures under test conditions and values used for design purposes.

While supplying fuel in the tank through fill pipes the level of fuel rises, displacing and pressurizing air and fuel vapor contained in the tank or introduced during the filling process.

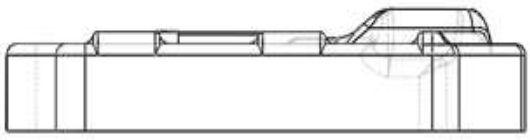
When the engine is running and filler pipe is closed, surplus fuel heated by its proximity to the engine while in fuel pump is returned via surplus line. The return of this heated fuel into the fuel tank also increases the internal vapor pressure of the tank. The safety vent valve bleeds air and fuel vapor from the tank to reduce the internal tank pressure, thereby ensuring that the internal tank pressure does not reach an unsafe pressure point. However, when the level of the liquid fuel in the tank nears or reaches valve by tilt or slosh, the valve closes to prevent dangerous leaks of fuel from the tank to the carbon canister.

V. OBJECTIVE

1) To make an optimized model in accordance with standard specification of HDPE fuel tank for better results than existing model.
2) To reduce the weight of the fuel tank resulting toward advancement in automobile industry. .
3) To reduce cost.

VI. RESEARCH METHODOLOGY

1) Fuel tank of Maruti Alto will be acquired and will carry on a CAD modeling to recreate the structure. This CAD model will then be subjected to Analysis as per ARAI specifications and then this model will be redesigned using HDPE material.
2) The HDPFE fuel tank will be analyzed as per the ARAI Specification with a view to optimize the new model.
3) Comparison between the existing and the new design will be carried out.



FRONT VIEW

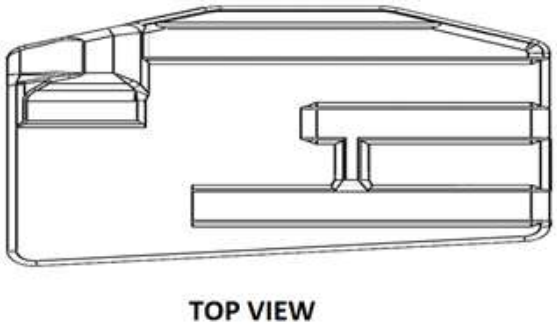


Fig. 1: Views of Fuel tank

Fig. 2: Fuel tank

VII. CONCLUSION

We conclude that the work which consists of the design, analysis and optimization of plastic fuel tanks used in the maruti alto car can be effectively presented. It is expected that the work will serve as a ready reckoner in defining the analysis methodology to prevent the damages. It is concluded that this work will give a suitable insight about load and pressure performance of the fuel tanks.

ACKNOWLEDGMENTS

I am thankful to Prof.A.P.Ganorkar, my guide for his encouragement and valuable technical briefs. I would also thank to all my friends who had helped and supported me all the time.

Last but not least, the backbone of my success and confidence lies solely on the blessings of my parents.

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