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Research Article

Fabrication, Prototype, and Testing of Acetylene Generator for Low- pressure Oxy-acetylene Welding

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Abstract – The Calcium Carbide based Low-Pressure Acetylene Generators are used extensively in India. The low-pressure Acetylene generator is used with an Industrial oxygen cylinder for oxy acetylene welding. These Calcium Carbide-based Low-Pressure Acetylene generators are manufactured by the welders or purchased from the market. In these used acetylene generators fewer safety measures are followed. They are unsafe due to their capacity, water level indication in the tank, and the bottom tank inclination. To overcome this gap in these drawbacks a prototype is developed and named as SHASHI (Stimulated Heated Acetylene Safe High Injection) is based to overcome these drawbacks. The dimension, temperature variations details are discussed in detail in this research paper. The prototype is tested for maximum 1.07 kg/cm^2 and at maximum temperature 72˚C. The shared information will certainly help for the researchers, welders and other associated members to further improvement in standardization in this field.

Keywords – Prototype, Acetylene generator, Low-pressure, Oxy-Acetylene, Water Tank.

Introduction –

The Calcium Carbide-based Acetylene Generator is very popular in India for generating Acetylene gas for Oxy-Acetylene welding. This Low-pressure oxy acetylene welding is very popular in Automobile workshops across India. This low-pressure oxy acetylene gas welding is used 0.1 bar pressure of Acetylene [1]. These Acetylene generators are mainly used in auto body minor repairing [2]. Other applications of low-pressure oxy-acetylene gas welding are for the joining of thin ferrous and non-ferrous materials, aircraft industries and sheet metal, fabrication plants [3]. Generally, 16 gauges to 22 gauges mild steel sheets are welded using these generators [2]. The Acetylene gas in Oxy-Acetylene welding is as highly flammable as GHS-US H-220 (Globally Harmonized System of Classification and Labeling of Chemicals) [4]. Acetylene is soluble in water 1200 mg/L at 25 °C [5] and soluble in water and many organic materials [6]. Acetylene is also reactive poisonous gas produce in the fire [7]. It is tending distant firing and flashback [8].

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The variation in design is found everywhere and this is depending mainly upon the welder's experience, ease of manufacturing of acetylene generator in India. Earlier in Abeokuta, Nigeria a study is conducted on working of these locally fabricated generators, welders' gender, age, efficiency, and problem associated with the oxy-acetylene welding process [9]. Another study was conducted in

Bida Nigeria on the local low-pressure oxy acetylene gas welding and discussed in detail the model's carbide and water used by the welder [10].

Analysis of present used Acetylene Generators –

As per BIS (Bureau of Indian Standards) SP: 12-1975 Handbook of Gas Welders the Low-pressure oxy-acetylene generators are divided as Water to Carbide and Carbide to Water [9]. They can be further classified into 4 types [10]. The design analysis of these four shows the prefabricated is the safest to operate [11]. The main drawbacks of popular prefabricated or readymade acetylene generators are-

- Water level,
- Inclined lower tank and
- Overall capacity of the Acetylene generator
- Flashback arrestor

Development of a prototype -

Based on these findings a new safe Acetylene generator prototype is designed and fabricated named SHASHI (Stimulated Heated Acetylene Safe High Injection) shown in figure 1.

Figure:-1

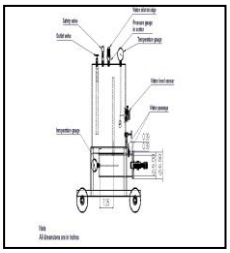
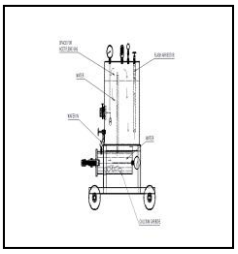


Figure:-2



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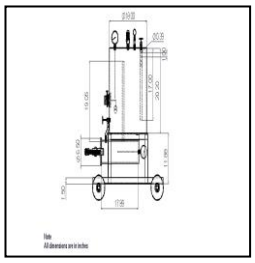

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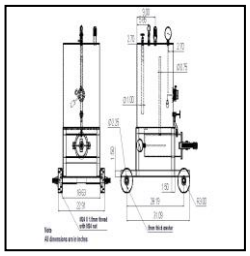

Figure:-5

The actual diagram of this acetylene generator is shown in figure 1. The position of temperature, pressure gauges, safety valve, etc. is shown in figure 2. The working diagram is shown in Figure 3. The figure 4 and 5 shows the detailed dimension of the prototype. The calcium carbide pieces are kept in the lower tank and tighten the lower tank cover. The water is stored in the water tank and release through a valve to the lower tank. The generated acetylene comes to the water tank through the middle pipe. The generation of acetylene can be control with a 90˚globe valve as pressure is required for oxy-acetylene gas welding. The generated acetylene is used from the top of the water tank. This process is quite common in almost all these types of generators. The drawbacks explained above are given priority to address in this prototype.

The overall water tank capacity is 78.3 Liters. The water storage capacity is 68.8 Liters. The acetylene gas storage capacity initially when the water tank is full is 9.55 Liters. It follows the 1/7 thumb rule usually followed using a dissolved acetylene cylinder. The lower calcium carbide cylinder is having a volume of 5.75Liters. As the water flow inside the carbide tank during the acetylene generation gives more space to the water tank to store acetylene gas.

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The water level in this type of acetylene generation is not shown. The welder generates the required acetylene approximately. The water level indicator also provides the welder to top up the water as and when required and hence reduce the excess production of acetylene gas. The welders hardly maintain this water level as many times the scarcity of availability of water near the welding shop. The water level indicator shows the level of water and to maintain the level inside the water tank. To show the water level inside the tank a multivalve of auto LPG cylinder is used. These multi-valves are tested to work at 20MPa. The flange for fixing this multivalve is also used in this prototype.

Mostly the lower calcium carbide tanks in this type of acetylene generator are fixed at an inclination of 15˚. This inclination gives an edge to the welder to clean the sludge in the lower tank easily. But the inclination reduces the capacity of the lower tank and the water insert in the acetylene gas pipe. In this prototype, the lower calcium carbide cylinder in the lower tank is fitted straight. The calculation shows that the capacity volume to store the water at a straight position is 5.63 Liters whereas in an inclined position the volume is 5.23 Liters.

As per BIS standard, a hydraulic back pressure valve is to be installed in all types of Low-pressure acetylene generators. But hardly any welders fix and maintain the water level in it. So a drilled pipe is fitted in the prototype the acetylene outlet so by any accident, the backfire arrives in the cylinder it will absorb the fire in the tank itself. This safety system provided an edge over other models to maintain a hydraulic backpressure valve separately.

Use of prototype Acetylene Generators –

The acetylene generator SHASHI is tested for a maximum of 1.07 kg/cm^2. But the maximum pressure is used in these generators for oxy-acetylene welding is only 0.1 Bar. The testing is conducted by installing a flashback arrester at the torch and at the Oxygen cylinder. The acetylene generator generates acetylene with the pressure required. The acetylene generator SHASHI is tested for all the types of nozzles sizes that are 0, 1, 2, and 3. The water level in the water tank was checked physically and found that capacity at ¾ 51.6 Liters, ½ 34.4 Liters, ¼ 17.2 Liters. All the parameters are matched as design after fabrication in the prototype.

Experiment results –

The fabricated acetylene generator SHASHI is further tested for dissipation of temperature on overall parts figure 6. The heat flux or thermal flux is also tested for heat flow rate intensity in W/m^2 shown in figure 7.

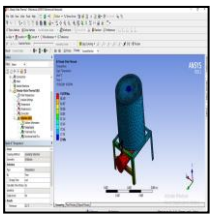

Figure:- 6

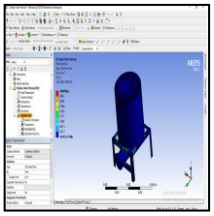

Figure:- 7

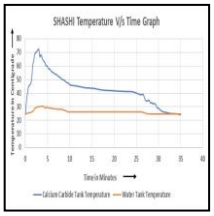

Figure:-8

The calcium carbide and water reacts and dissipates 64 kcal [12]. The highest temperature is measured at a calcium carbide tank of 72˚C. The water tank and calcium carbide tank are plotted in figure 8.

Conclusion –

The acetylene generator SHASHI is tested and found safe in all aspects. The increased water capacity and water level indication ensure that the water temperature is not increased above 30˚C at water temperature. The calcium carbide tank straightness insures more amount of water in the tank. At last, the perforated structure ensures that the backfire can be arrested properly. But during this study, it is observed that no welder is using the hydraulic valve, welding arrester, and not even hand gloves to clean the sludge. The automobile specifically cars numbers are increasing and these acetylene generators are used mainly maintained them. These safety features in this prototype ensure a safe welding process. More awareness and safe working are highly required in this field to ensure a safe working environment.

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