High pressure resistant glass sphere

Okamoto Glass Co., Ltd.

1. What's the high pressure resistant glass sphere?

The container for deep sea investigation activity is required high pressure resistant function. 80MPs pressure capacity in the 8,000 meters depths and 100MPs pressure capacity in the 10,000m depths of the sea are needed. In general, the container with high pressure resistant is used the material which are metal (mainly titanium alloy), ceramic and glass. The thermal energy for melting material at the pressure container manufacturing is bigger than in order of ceramic, metal, glass, also glass is the environmentally friendly material compared with other materials. In case the pressure resistant container is disappeared at under the sea or seabed if by any chance, because glass itself resembles in geological structure of earth crust, it is good for ecology to dissolve in ocean water and return to earth for a couple of hundred years.

2. Outline of our developing product

We, Okamoto Glass developed a 13 inches high pressure resistant glass sphere for withstanding water pressure (80MPa) of depth of 8,000 meters. The point of developing success is to optimize the matching surface design of two halves and improve the processing accuracy. The power of 2,700 tons press hard on the surface of the glass sphere in the deep sea of 8,000 maters. Pressure resistant glass container is built by fusing two halves together and it is built to take a high pressure to matching surface of two halves. We calculated the compression stress and stretching stress in the deep sea by simulation and realized optimum design that maximum stress doesn't concentrate to a part.

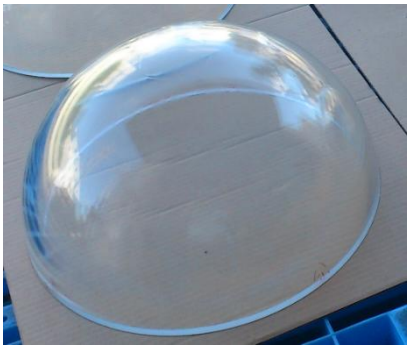

Fig.1 13 inches pressure resistant sphere(Half sphere) made by Okamoto GlasS

3. Design of pressure resistant glass sphere with 80MPa

① To select of material

Glass has an isotropic three dimensional network structure in a homogeneous atoms each other tightly bound. Unlike metal or a polymer, there is no weak parts of intensity because of without dislocation and grain boundary, and the theoretical intensity is extremely high. For pressure container that has a function as a buoyancy body, borosilicate glass which is small gravity was selected as material for the glass sphere.

The glass material with strong bond network and young's modulus was selected among them.

② Shape design

The glass sphere is designed to minimize the compressive stress and stretching stress.

Regarding to the shape of fusing part at equator surface of the pressure resistant glass sphere, we calculated the compression stress and stretching stress by simulation and realized optimum design that maximum stress doesn't concentrate to a part.

③ Mold accuracy

Flatness and vertical at the equator of our glass spheres are single digit better than the glass sphere made in German and American.

Our made of glass spheres are those an order of magnitude higher than the Germany ball-America sphere flatness and vertical of the equatorial plane is preceded. Since only processing have a limitation in accuracy and eventually succeeded in improving the flatness and vertical by additional processing with utilizing jig.

4. Sales result

We, Okamoto Glass has delivered 34pcs of 13 inches pressure resistant glass sphere in 2014, and

We presume this quantity would be 17% market share in domestic.

5. Summary

Okamoto Glass has been manufacturing and suppling special glasses for industrial use to our customers which are both domestic and oversea since the day of establishment in1928. But we have just started to develop the pressure resistant glass sphere for deep sea since 2012 and had not experienced maritime products market so far. With the development of the glass sphere, we would like to contribute to develop the maritime products market by providing high reliable and affordable products.