Analyzing the Effect of Fabric Reinforcement on Some of the Properties of Rubber Diaphragm

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Abstract—This study involves the result of an effect of use of elastomeric fabric on rubber coated diaphragm. In such cases when rubber is composite with some fabric material it will have revised and improved property. In this paper it is been studied how Spandex® (elastomeric fabric) improves quality of rubberized diaphragm. The experiment investigates comparison with other fabric reinforced diaphragm. Fabric reinforced diaphragm made up of polyester, nylon, Kevlar and cotton which are used in market. Spandex has higher elongation property with high strength than other fabric. For making reinforced diaphragm fabric has been placed between two rubber sheets. Spandex is favorable knitted fabric. Molding is been carried out on RIf treated fabric for nitrile rubber. Testing is than carried out to analyze diaphragm property with parameter.

Key words: Elastomeric Fabric, Rubber Diaphragm, Rubber Bonding Agent, Screw Molding Equipment

I. INTRODUCTION

The diaphragm valve traces its origin back to the ancient Roman and Greek times, where it was used to control the water and temperature of the hot baths. With a crude leather diaphragm that was manually closed over a weir, it was a primitive but effective control valve. Diaphragm pressure gauges are replaced to Burdon pressure gauges. As compared to Burdon tube diaphragm gauge has high actuating force. An enclosure consists of a flexible sealing device which isolates accordingly is a diaphragm. The diaphragm is the most critical component of a diaphragm valve. The flexible nature of diaphragm calibrates pressure difference. A diaphragm is built on an edge of the subject where pressure imparts from one side. As pressure from one direction bends the diaphragm from one side the other side where indicator converts the amount of pressure to the pointer in dial calibrates actual pressure. [1, 2]

Diaphragm is a time proven product and offers longest cyclic life in industry. It provides positive shut-off isolation between the fluids. Diaphragm design gives a smoother and more efficient operation.

II. VARIOUS SHAPE OF DIAPHRAGM

The diaphragm can be made into different shapes. It can be modified in flat shape, convoluted shape, dish shape, rolling shape diaphragm.

III. DIFFERENT TYPES OF DIAPHRAGM

A. 100% Rubber Diaphragm

Rubber diaphragms are manufactured from various kinds of rubber material i.e. Nitrile, neoprene, silicon, SBR, EPDM, fluorocarbon rubber, etc.

B. Rubber Coated Fabric Diaphragm:

These diaphragms are prepared from rubber coated fabric and drawn by means of a thermoforming process. The rubber coated fabric having a fabric insertion coated on both side by thin sheet of rubber. These diaphragms have ability to work at high pressure.

I) Reinforced Diaphragm:

As rubber coated fabric diaphragms are prepared by shaping the fabric, reinforced diaphragms are prepared by molding process where a fabric is inserting between two sheets of rubber. Compared to the rubber coated diaphragms fabric reinforced diaphragms are reliable. [3, 4]

This paper is related to a diaphragm for a diaphragm valve and more particularly to a manner of reinforcing the diaphragm with fabric. The part of such a diaphragm which is in contact with greatest stress concentration and the central portion which is in contact with enlarged head of a stud. This practical is particularly concerned with reinforcement to withstand stresses in the latter portion. Fabric reinforcement sustained rupture of the diaphragm due to its deformation while in use.

Fig. 1: Fabric Reinforced Diaphragm [5]

Fig. 1 shows the cross-sectional view of an elastomeric material diaphragm provided with fabric reinforcing layers according to the practical. This specimen formed of nitrile rubber sheet having reinforcement of an elastomeric fabric. The diaphragm may be oval, round or any other shape in flat type. [5]

In this study it has taken spandex fabric as reinforcement. The property of Spandex® fabric is to impart stretch ability and shape retention properties. Spandex® or
spandex is the most durable alternative, offering a great improvement over rubber. Although rubber is excellent in elasticity, it has textile limitation in strength, flexibility, recovery force properties. Before molding process fabric been treated with resorcinol formaldehyde latex. In this study the sustainability of diaphragm is analyzed.

The molded elastomeric diaphragm is a tough, versatile dynamic seal that eliminates virtually all of the problems and limitations associated with other sealing methods such as U-Cups, O-Rings, metal bellows and flat, die-cut diaphragms.

Compare to alternative techniques, molded diaphragms do not leak, offer no friction, have exceptional sensitivity, and display a hysteresis that is, in most cases, negligible. Require no maintenance or lubrication, and are extremely cost-effective in most applications. [4]

To achieve objective the practical is going to be study the bursting strength, cycle loading and work of rupture for subjected fabric reinforced diaphragm.

IV. MATERIALS AND METHODS

For the fabric reinforced diaphragm single jersey plain knitted fabric is using. The specification of fabric is open width 70-72 inch with 190 gsm. In cotton Spandex fabric cotton count is 36s Ne, and contain 4-5% Spandex percentage for adhesion purpose a coat of RFL (resorcinol/formaldehyde/latex) is applied on spandex.

V. SAMPLE PREPARATION

Sampling is carried out accordingly standards such as D 3786 and D 638.

A. Practical Method:

In this design type of fabric is decided by its capacity to sustain load. An engineered fabric is utilized for diaphragm manufacturing. The layer of fabric gives diaphragm high pressure sustainability. The fabric layer gives flexibility to diaphragm. In this practical an elastomeric fabric (spandex fabric) is been utilize for diaphragm preparation. A required amount of rubber material is been use for molding process. Before molding process, the sampled fabric is been coated with adhesive which is uncured elastomeric resorcinol formaldehyde latex. As it gives proper binding with the sheet, avoids sliding of fabric. Samples are prepared under screw molding mechanism, where process carried out at 137˚C for 5-7 minutes under manual load.

VI. TESTING METHODS

A. Bursting Test Methods:

Generally tensile strength tests are used for woven fabrics where strength can be measured in warp and weft direction. However, certain fabrics such as knitted materials, lace or nonwovens where they are not having such distinct directions where the strength is at a maximum. Bursting strength is an alternative method of measuring strength in which the material is stressed in all directions at the same time and is therefore more suitable for such materials. The test is carried out as per ASTM D 3787.

VII. RESULT AND DISCUSSION

In this practical the test is carried within different types of fabric reinforced diaphragm.

![Bursting strength (N)](image)

**Fig. 2: Bursting Test Report**

The graph shows the comparison of different fabric reinforced diaphragm having kind of fabric inserting material. It can be seen that the cotton has high load sustaining property. Although spandex comes on the second stage it has good extension property. While other material gives lower result.

![Extension (mm)](image)

**Fig. 3: Extension (mm)**

REFERENCE