By Daniel Pascoe

Vacuum Foam

There are certain applications where traditional vacuum cups can't be used in material handling because they are unable to seal against a rough or uneven surface. One of the few alternatives to rubber vacuum cups is vacuum "foam" as shown in *Fig. 1.* The foam sheet shown in *Fig. 1* comprises of a number of holes that replicate a vacuum cup with the foam "web" between each hole acting as the seal. Therefore, this foam plate is, in a sense, the same as an array of numerous vacuum cups demonstrated in *Fig. 2* where the plenum is holding down a fabric surface for the purpose of providing a visual example of this.

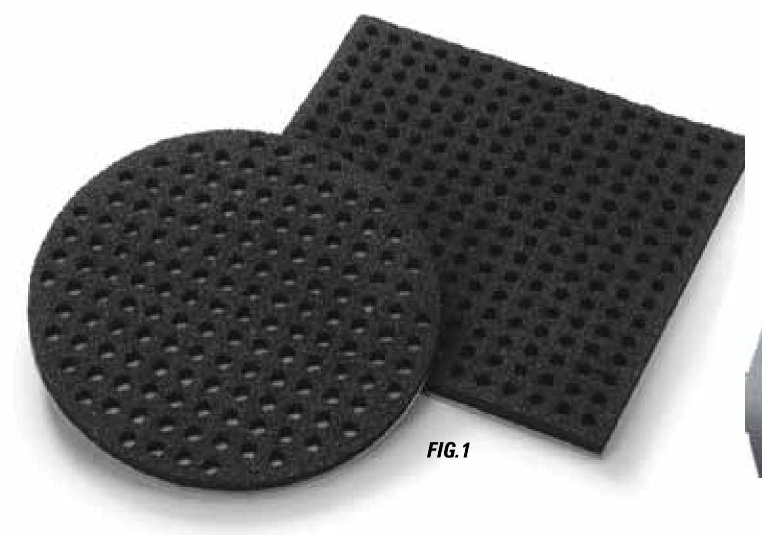


FIG.1

FIG.2

The term *foam* is misleading or misunderstood. The actual material is a closed cell foam rubber. This means that the construction of the material consists of a sheet of rubber that has been manufactured with a foaming agent trapping air bubbles within the material. *Fig. 3* shows a typical cross section of this material with a pen used as scale. This foam is typical of the type used in vacuum lifting.

The benefit of a closed cell foam rubber is its ability to deform to the product being handled. *Fig. 4* demonstrates the foam deforming to a decorative stone surface. The seal is created as the foam is pressed against the stone. Vacuum is then applied, and with an air-tight seal, the stone is able to be lifted. Often a perfect seal is not achievable because of the coarseness of the product, but because foam "cups" are usually quite large in diameter, offering a significant surface area, only a low vacuum level is required.

FIG.3

For example; a four-inch internal diameter cup (such as the one shown in *Fig. 5*) has a surface area of 12.57 in² (2 x 2 x π), which offers a lifting force of 184.8 lbs (12.57 x 14.7) at full vacuum. (14.7 psi is one atmosphere.) Consequently if a vacuum level of 10 "Hg is being created, an actual lifting force of 61.6 lbs is available.

Vacuum foam is often used in these types of coarse product lifting applications. Another application is when the user is handling bags. One of the problems when picking up bags is the standard rubber vacuum cup, although being able to seal against the bag surface, is not able to withstand large inertia in machine movement, as the bag sways or peels away from the cup lip, because the contents of the bag tend to "sag" in the center. Therefore, using a foam perimeter seal, bag lifting is achieved with some ease. *Fig. 6* demonstrates a foam seal holding a bag of coffee, which is particularly difficult because granular material inside a bag, such as coffee, gathers in the center. This vacuum foam seal offers incredibly strong and, more importantly, an evenly spread holding force across the bag area.

So, what is the disadvantage of foam? When compared to standard rubber vacuum cups, the most obvious failure of foam is the life cycle. Foam, depending on the application, can wear extremely quickly compared with rubber vacuum cups. This has always been the downside of using a foam rubber. Of course there is good and bad foam available, but the trade off you get when using long-lasting foam is the inflexibility of the foam in sealing against a part. The lower the Durometer normally means the shorter the life.

Many types of foam are available based on Durometer (hardness), density, and material compound, and in many cases, a "suck it and see" trial is often undertaken. Unfortunately for the user, the life and subsequent replacement cost is rarely a transparent cost in the initial system proposal.

Good vacuum foam will offer a reasonable life as well as good performance.

Another consideration when using vacuum foam is the cycle rate. One of the features of foam is what is referred to as *memory*–the condition where the foam "remembers" the shape or profile of the part being handled. This is not a good feature, because as the vacuum tool releases the product and returns to pick another part, the foam has yet to return to its original shape. Therefore, the compression rate of the foam has decreased and consequently has less of a chance to deform to the part profile in time. What's normally experienced by foam with a short memory (good) is poor deformation against very coarse surfaces (bad).

Over time, the foam will also flatten. This is due to the small air bubbles inside the foam bursting. In some extreme cases, especially when the foam is being used at a high vacuum level (which as explained before is not normally necessary), the foam resembles a flat rubber gasket where all the air bubbles have been destroyed.

When considering a vacuum foam for handling parts, these benefits and disadvantages need to be taken into account. There are numerous manufacturers of foam, however very few of them are experts in its use for vacuum part handling.

A good vacuum foam has a reasonable life, good sealing characteristics, and short memory—all of which offer the user a cost-effective and productive solution to their handling needs. Rubber vacuum cups are the preferred choice, due to longer life and consistent performance, but if they are unable to seal properly, vacuum foam is the second choice, and this article explains some of the basic considerations when foam selection is undertaken.

This article is intended as a general guide and as with any industrial application involving machinery choice, independent professional advice should be sought to ensure correct selection and installation.

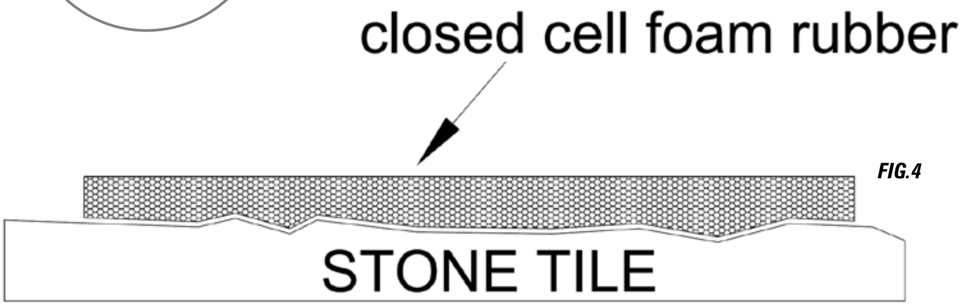
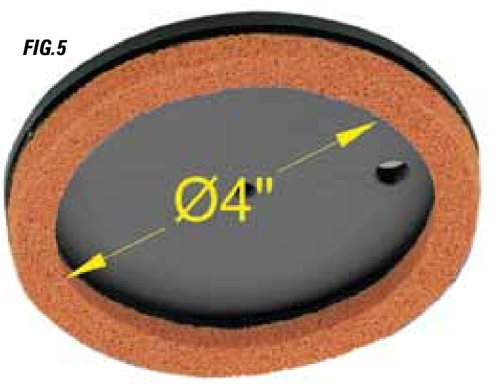


FIG.4

FIG.5



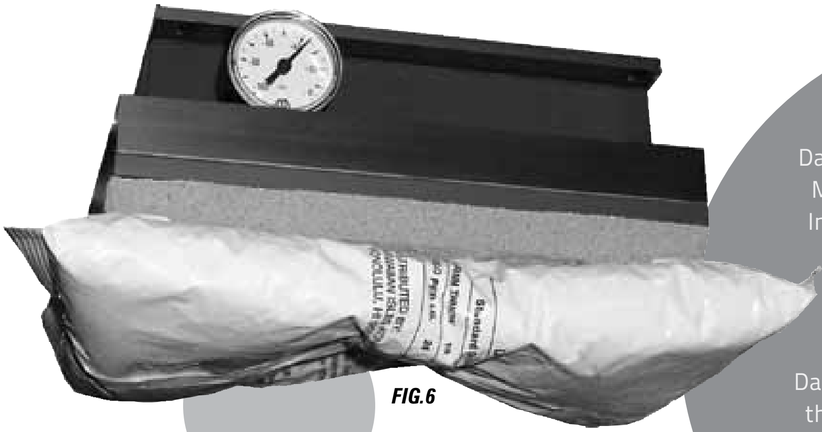


FIG.6

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