Nonwoven Metallic Fabrics

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INTRODUCTION

Nonwoven metallic fabrics are highly versatile combinations of conductive and textile fibers, or entirely conductive fiber structures produced by a specialized manufacturing method. They are fabricated on highly modified textile-type equipment which is capable of processing conductive fibers, or blends of conductive fibers and synthetic or natural fibers, into nonwoven web fabric structures.

Conductive nonwoven fabrics provide efficient shielding when incorporated into composite structures or combined with engineered resins.

CHARACTERISTICS

Nonwoven conductive fabrics are characterized by highly randomized, non-oriented fiber arrangements which are normally metallic in nature. The metallic fibers comprising the fabric can vary in diameter and alloy or can be combinations of different alloys and diameters.

Fabric weights can also be varied, with the lightest weight product being one ounce per square yard. There are few limitations on producing heavier weight fabrics. Densities or porosities can be customized depending upon the degree of consolidation and the fiber diameter utilized. Physical appearance can range from paper-like to that of a loose fiber batting-type structure.

Nonwoven metal fabrics can be stabilized through sintering, polymer bonding, or, in the case of the finer fiber diameters, through consolidation with fiber-to-fiber friction.

Conductive nonwoven fabrics provide very efficient shielding when incorporated into composite structures or combined with engineered resins. In most cases, this is accomplished with minimal difficulty or effort due to the uniformly open structure inherent in the product. Existing equipment and manufacturing methods can be utilized with little or no modification. Because of these features, additional resource allocation is seldom required to capitalize on the advantages inherent with conductive web products.

Since conductive web can be produced in 300- or 400-series stainless steel fibers, it has outstanding corrosion resistance. In general, web can be manufactured from 4, 6, 8, 12 or 25 micron diameter fibers. These fine fiber diameters make it possible for a uniform coverage web to be produced at minimum weight levels. This is an important advantage where weight restrictions apply to the end-use product.

A high performance level can be achieved with a single layer of conductive web weighing only 4 ounces per square yard. The desired degree of fabric openness can be obtained by selecting the proper fiber diameter in the appropriate weight range. As a general rule, fiber diameters of 8, 12, or 25 microns should provide enough flexibility to satisfy most applications.

The web products are compatible with most resin systems and reinforcing fabrics. They are easily wet out and therefore the tendency to delaminate is minimized.

When using conductive web in composites, no additional process steps or resin are required. The web is simply laid up with other reinforcing fabrics or prepregs in the normal manner. Since the web does not absorb resin, the excess in the prepreg is usually sufficient to produce good parts.

RIM, RTM and compression molding techniques which utilize liquid resin systems are also excellent for attaining highly effective shielding through the incorporation of conductive web. The major change required would be to center gate the mold to prevent the web from being pushed away from the edge of the mold by resin flow.

APPLICATIONS

High efficiency conductive gaskets can be produced by impregnating the web or layers of web with the proper elastom-

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eric material. Gaskets can then be die cut from sheets of the impregnated web. Alternately, the sheet may be slit into tape and the tape placed on the edge to provide a direct conductive path between conductive surfaces.

By utilizing maximum fiber length, and therefore maximum conductive length, along with random, even fiber distributions, the best possible conductive network is achieved. A preformed network of conductive fibers will afford performance consistency which cannot be matched by other types of conductive fillers.

Conductive webs can also be used as TEMPEST suppression materials. They are effective shields, lightweight, easy to laminate and install in rooms or buildings, and are corrosion resistant in most atmospheres. Recent MIL-STD-285 shielding tests at 3, 7 and 10 GHz indicate that selected webs perform at the dynamic range of the test equipment.

TEMPEST suppression equipment enclosures can be produced using RIM, RTM or liquid thermoset resin systems. Conductive web may be the best method of producing enclosures with attenuation efficiencies high enough to be acceptable.

Nonwoven conductive webs are also excellent materials for antistatic protection. The web structure forms a protective shield which dissipates the energy and prevents the charge from penetrating further. The web should be placed as close to the surface as possible if maximum protection is to be achieved. In this way, even if the web is totally encapsulated with resin, sufficient numbers of fibers will protrude through the surface to produce a conductive surface and a direct connection to the main body of the web, which will spread and dissipate the charge.

CONCLUSION

While conductive webs will not satisfy every shielding need, it is obvious that they will find increasing applications in a multitude of product areas. As attenuation requirements become more demanding, metallic conductive webs will increasingly become the product of choice to meet these new needs.

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