VOICE COIL
THE PERIODICAL FOR THE LOUDSPEAKER INDUSTRY

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IPT's New Voice Coil Bobbins and Collars

By Mike Klasco

At the China loudspeaker seminar, new voice-coil collar materials were introduced. Innovative Paper Technologies, also known as IPT, is a new name for speaker engineers.

But IPT knows the voice coil industry well, having bought the assets and homesite of Quin-T in Tilton, N.H. Over the last 40 years, Quin-T developed many of the popular collar materials used by the voice coil industry.

Today, Innovative Paper Technologies, LLC is an organization of specialists who research, design, and manufacture unique inorganic papers that have application to voice coil bobbins and collars. Recently IPT has pioneered the development and production of a new generation of products which are performance-engineered to meet the most rigorous applications at temperatures over 250° C. These materials have been refined, tested, and proven in a wide variety of applications—including use as high temperature voice coils; electrical insulation in transformers, motors, and generators; and flame barriers in household appliances.

A Look at Speaker Collars

Let's take a look at the requirements for voice coil collars. A collar is one or more turns of a band of material located just above the coil winding stack and the cone/spider neck joint. Often, and for good reasons I will address, the collar extends into the neck joint. Primarily the collar is used to properly dress the lead-out wires from the coil holding them to the bobbin. Alternatively, lead-out wires may be glued directly to the bobbin. Still there are quite a few sound reasons to use a collar.

Increase Bobbin Strength

A collar is used to stiffen and strengthen the space between the voice coil and the neck joint. While the voice coil winding provides the mechanical integrity of the voice coil assembly, the space between the top of the coil winding and the neck joint (where the spider and cone meet) can be susceptible to crumpling, especially on high power woofers. The collar increases this Achilles' heel of the voice coil.

Thermal Management

If a thermally non-conductive or limited thermally conductive collar material is used with aluminum or other thermally conductive bobbin material, then the neck joint adhesive and cone material will be subjected to less heat from the voice coil. Neck joint adhesives have many requirements, and if parameters other than ultra-high temperature tolerance can be accommodated, that is the preferred approach. Poly cones with aluminum voice coil bobbins that will be used at high power really need a thick thermally non-conductive collar to avoid heat warping of the poly cone.

Dimensional Fudge Factor

The collar may be used to build up the outside diameter of a stock bobbin in order to fit an existing cone body. Somehow the inventory of cones and voice coils never seems to exactly match up. If the bobbin is slightly smaller in diameter than the cone internal diameter, you need to build up the bobbin to

PHOTO 1: Aerial shot of the IPT plant located in the foothills of the White Mountains.

produce a friction fit between the bobbin and cone body.

The optimum selection of adhesive will be affected by whether there is a loose fit or a friction fit between these parts. It is unheard of in the summer for the viscosity of the adhesive to thin out and drip through the voice coil/cone joint onto the voice coil. Because most woofers are assembled face up, the adhesive leakage bead on the voice coil can ruin the entire speaker.

Adhesive Interface

Many cones, especially poly, and many bobbin materials, such as polyimide and even aluminum, are not easy substrates to bond to. A rough material, such as a ceramic paper, kraft paper, or spun lace Nomex, provides a receptive interface for adhesives between the bobbin and cone.

Acoustical Properties

By astute selection of collar material and thickness, the speaker designer can utilize the collar to control the top end response of the speaker driver. If a woofer or mid-range speaker has a rising response, perhaps due to beaming, instead of using a second-order network to tame this, a thicker collar material might be the optimum solution. IPT has 5 mil, even some 10 mil, materials. With this thick collar between the bobbin and the cone, the excess upper midrange energy can be attenuated before it ever reaches the cone neck.

Collar Material Selection

Collar materials are often selected because they are very pliable and absorptive. And as I just mentioned, absorptive materials are easier to glue to, resulting in a good bond between the collar, bobbin, and the cone. Only Kapton HPP and Kapton MTB bobbin materials are treated for high adhesion. The more commonly used Kapton HN is not treated, so bonding it or the lower grade Chinese polyimides without a collar to other low adhesion materials such as PP (polypropylene) cones can be troublesome.

If the collar material is absorptive, then it is not compatible with ferrofluid, which may be absorbed into the collar material, changing the effective moving mass and resulting in unstable characteristics over time. But good adhesion characteristics do not necessarily require absorption; a rough non-absorptive surface texture may also allow good adhesion. The key to finding a good collar material that is compatible with ferrofluid is locating a rough surfaced, but not absorptive material. Ideally, an intrinsically non-absorptive material, such as IPT's TufQUIN, should be used.

Pliability (soft and easily moldable) is an attractive characteristic because the collar material must conform closely over the lead-out wires. If the collar material does not tightly seal the lead-out wires against the bobbin, then whistling noises may result. Additionally, a loose collar provides a capillary path by which ferrofluid can migrate from the gap. To prevent ferrofluid from migrating between the lead-out wires and the collar, I recommend a gel-type adhesive over the lead-out wires applied along the length that will be covered by the collar.

PHOTO 2: Gamma gauge monitoring the quality of the paper as it comes off the paper machine.

Common Materials

Untreated Kraft paper is popular for collars, because it is inexpensive and easy to work. It is not appropriate for thermally conductive bobbins that must withstand high temperature operation. Kraft paper is also highly absorptive and thus is not a good choice for use with ferrofluid, and even treated Kraft paper is not a good choice for ferrofluid-treated speakers.

DuPont Nomex 411 and 410 are often used for collars. Nomex is harder to work than kraft paper. Resin-treated Nomex is often used to reduce the dimensional instability and moisture absorption of Nomex. Still, even resin-coated Nomex should be avoided with ferrofluid-cooled speakers, because the edges produced during the slitting process expose uncoated surfaces that can be absorptive.

IPT's CeQUIN & TufQUIN are well-known and popular with voice coil winders worldwide. Acoustically, CeQUIN and TufQUIN products have always excelled. Both materials possess good thermal stability and TufQUIN non-absorptive properties.

IPT: A Closer Look

At the China seminar, IPT introduced its new Thermal Shield and ThermaVolt papers to the speaker industry. Before I discuss these new materials, let's first take a look at IPT's established collar materials.

CeQUIN

Minimum thickness for CeQUIN papers is 3 mils (.08mm). CeQUIN papers have been successfully B-stage coated by several companies here and abroad. They will withstand very high temperatures in processing.

TufQUIN

TufQUIN papers, while not as high temperature resistant as IPT's CeQUIN papers, will withstand fairly high short-

term temperature exposures. CeQUIN and TufQUIN are both used with high performance B-stage coatings for collar applications. TufQUIN 110 offers a number of characteristics, including ferrofluid compatibility, that make it attractive for use as a collar material.

TufQUIN 110 is flexible and conformable, capable of high temperature service through class H (180° C). Additionally, it has good physical toughness—high stiffness, tensile strength, and tear resistance, plus low moisture absorption—no need for coating or sealing—with less than half the absorption of Nomex 110. Minimum thickness for TufQUIN papers is 2 mils (.05mm). TufQUIN Kb is a black version that is preferred by many voice coil manufacturers.

Thermal Shield

Thermal Shield non-woven polyphenylene sulfide (PPS) sheet is designed for use in applications requiring long-term exposure to high temperatures as well as resistance to chemicals including ferrofluids. It is not susceptible to hydrolysis and does not require baking out for dimensional stability. Thermal Shield may be resin-coated to enhance its performance, and is a drop-in replacement for the spun-laced Nomex for collar applications. Thickness range for Thermal Shield is a bit over 2 mils to 7 mils (.38mm). Like Nomex, it would need to be coated with B-staged resin to make it suitable for most collar applications.

ThermaVolt

ThermaVolt high inorganic content paper was originally developed for use in high temperature (class 220 R), dry-type transformers. ThermaVolt offers good thermal conductivity. It is an especially attractive solution where some thermal transfer is desired from the bobbin to the cone—as in the case of an aluminum bobbin to an aluminum cone. It has low moisture absorption and is dimensionally stable, which is a plus over spun lace aramids such as Nomex. Thicknesses: 3 mils (.08mm) to 10 mils (.25mm).

Future development of ThermaVolt inorganic papers with polyimide coating shows promise for high performance midrange and tweeter bobbins.

Conclusion

The lowly collar might be one of the least expensive components in a loudspeaker, but it provides many important benefits to the voice coil and to the driver itself. In addition to improving the coil's structural integrity and securing the lead wires, the collar can serve as a thermal insulator and may be used to improve the adhesion between the cone and the voice coil bobbin. Also, the acoustical properties of the collar may be selected to influence the top end response of the speaker.

Many materials are available for use as a collar, but a careful understanding of these materials' physical properties is required for optimum selection. New, innovative materials from IPT provide the designer and manufacturer with low cost, high-quality alternatives to commonly used collar materials.

For more information: www.iptllc.net. *VC*