The Vacuum Tube

Tube Bases and the Asbestos Hustle

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It's been said that if your drinking water is "hard," you can remove the dissolved carbonate compounds by placing magnets strategically on the incoming pipe. To improve the sound quality of your CD player, run the output through a pair of Western Electric repeating coils. And if you develop lung cancer, blame the asbestos in the bases of receiving tubes.

Society may be in a new Dark Age when it comes to popular understanding of basic science. The growth of ignorance and superstition not only has mind-stunting effects in its own right, but half-understanding of the physical world may suggest opportunities to make money via false litigation.

At least three lawsuits have arisen in the last few years charging that asbestos in the bases of receiving tubes manufactured years ago had caused lung cancer today. In one case, a radar technician from the '60s, stricken with mesothelioma, was able to recall the brand name on some of the tubes with which he had worked. That company is still in business, although long gone from tube manufacture. Bingo! Following the established common-law principle "cuius pocketa profunda, ejus liabilitas" (he who has deep pockets has the liability), out came the suit. Note that no one is trying to sue defunct makers like, say, Arcturus or National Union.

General Plastics, Inc. featured Sylvania tubes in its 1929 Radio Engineering ad for Durez base material.

In hope of dispelling the mumbo-jumbo surrounding this topic, some straight talk from industry sources may be helpful. To start, RCA published a chart of "Materials Used in RCA Radio Tubes" in their RC-12 manual of 1934. The list includes some nasties like arsenic trioxide, cesium, and mercury. It cites "wood fiber" -- the common filler material in phenol-formaldehyde moldings like tube bases -- but does *not* mention asbestos. The wood was typically spruce.

The practice of industry leader RCA as to base materials is evident from a 1962 internal publication [1]. Four types are mentioned:

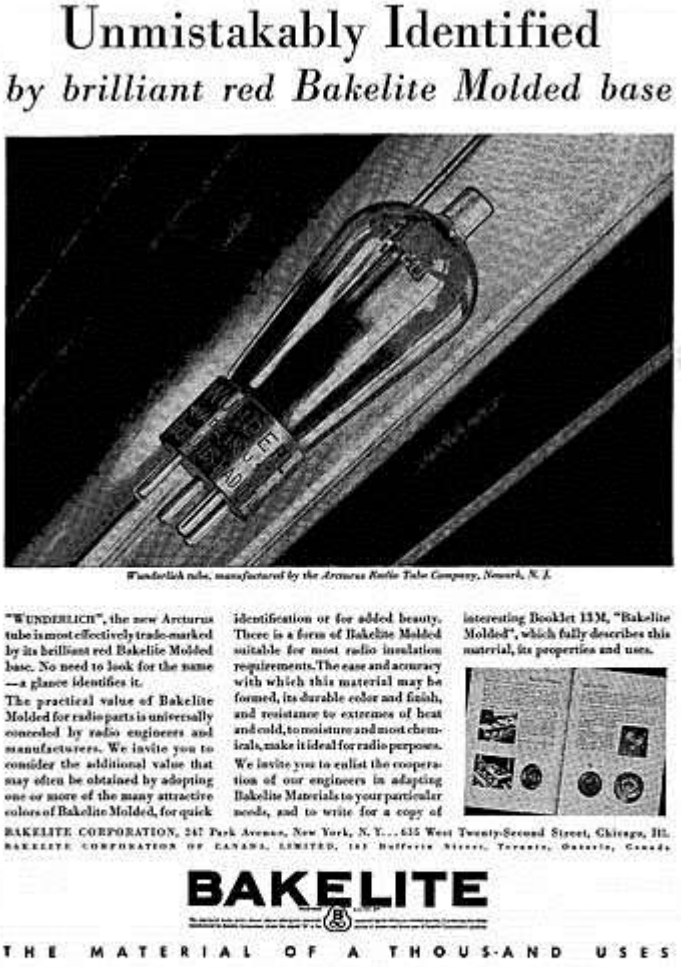
(1) A general-purpose, wood-flour-filled black phenolic material used on most receiving and picture tubes. A wide variety of grades of this material was used for different applications. For example, picture tubes, which usually operated at high voltages, required a base grade having a high dc resistance; receiving tubes were usually not critical as to base resistance.

(2) Molded melamine, a material of very high dc resistance which, because of its high shrinkage on aging, was not much used.

(3)Plaskon, an alkyd-type material used mainly on phototubes or other tubes requiring bases that would maintain extremely high dc resistance under adverse moisture conditions. Plaskon has the one disadvantage of being very brittle and easily cracked.

(4) Micanol, a mica-filled phenolic, was used for high-frequency applications, particularly on power tubes. Micanol has extremely good dc-resistance characteristics; it is, however, extremely difficult to mold and is more expensive than the other materials described.

The black phenolic molding compound that RCA used was of several brands. As of 1946 it was described as "Bakelite," specifically Bakelite Corp. BM120 or BM3703 [2]. Later it was termed more generically



The vanishingly rare top-cap version of the Wunderlich, a detector from Arcturus with a glamorous red Bakelite base, decorated a Bakelite Corp. ad in Electronics for July, 1932.

"phenolic resin," under the commercial names Durez 791 (for all plants except the Lancaster location), Durez 792, Bakelite BM2005, Bakelite BM12265 (for color picture tubes), and Plenco 418 (Lancaster only) [3]. An earlier tabulation [4] mentions an equivalent compound named Moldarta, and there may have been others.

The colored bases on "Special Red" tubes were apparently of Bakelite BM17119. The Bakelite-brand products seem to be gone from the market today, but Durez 791 is available -- the maker calls it an "industrial standard" for general phenolic moldings. Micanol bases, found on special-purpose tubes, substituted ground mica for the wood-flour filler. The specific compound was Bakelite XM15714 [5].

Micanol was the material that admirers of National Company receivers will recognize as "R-39" material. It had the virtue of not absorbing water vapor, and thus was important for high-stability oscillator tubes like the 1626 and 6SJ7Y. (Water has a dielectric constant of 80, and so is unhelpful in terms of the capacitance of an insulator like a tube base.) Micanol was also an effective RF insulator, helpful in the 6146 power amplifier. It had good resistance to high-voltage breakdown, and hence appeared in the 5R4GY rectifier.

"Bakelite" molding compounds could incorporate other filler materials, specifically powdered glass or asbestos. Asbestos filler was available for special uses like high-temperature applications in the '20s, and is apparently still on the market. Its field of use was more in laminated sheet plastics than in moldings. For general electronic applications, more modern molding compounds with superior RF and high-temperature characteristics had replaced asbestos fill had by the late 1940s. These were materials like improved steatite, Mykroy, or Micalex.

As an example, the 1943 edition of one major reference handbook [6] lists seven variants of "Bakelite," including one version with "mineral" fill, which one suspects is asbestos. The 1949 edition [7] cites only three "Bakelite" compounds, and the "mineral" version is gone. A later tabulation [8] lists the dielectric constants for 19 polymer molding compounds, of which three phenolics are listed: cellulose-filled, glass-filled, and mica-filled. There is no mention of a resin with asbestos fill.

Now, let's turn things around. We'll suppose that tube bases did have asbestos fill. In the molding process, the Bakelite resin famously flowed around the particles of filler, forming a hard-shell surface that firmly encapsulates them. One could presumably grind a base up and snort the resulting powder, but this seems unlikely. Of course, nobody is pointing fingers at, say, Bakelite radio cabinets. With asbestos filler, those would have represented a far more common, even if still unlikely, health exposure.

As a side angle, there has been some worry that the cement used on tube bases might have been a health hazard. However, that product is innocent. This recipe for RCA's basing cement, yielding about 200 pounds of material, was "standard for all bases." [9, 10]:

Coarse marble flour	170 lb.
Orange flake shellac	19-1/2 lb.
Durite phenolic resin LR275-2	7-1/2 lb.
Medium-color (grade G) rosin	3-1/4 lb.
Denatured alcohol	9 liters

Malachite Green aniline dye 10 g.

(Just for reference: the above recipe yielded enough cement to put bases on 23,000 Type 50 tubes. The dye gave a rough indication of curing temperature by losing its color near the desired 150ºC. RCA's product was quite similar to a basing cement offered in recent times by Osram-Sylvania for CRTs and light bulbs. Note the mix of English and metric units, a common practice in the tube industry.)

The above discussion reports on the practices of RCA. The other makers didn't necessarily use the same materials. However, in the marketplace for "commodity" receiving tubes, the manufacturers closely observed each other's products. Nobody had any special technology. Indeed, the makers were busy selling each other finished tubes and parts. For example, Westinghouse had a labor strike in 1956 that shut off the supply of bases for use in RCA's 5R4GY, the "special red" 5691 and 5692, and the 6080.

More information on Bakelite and its restoration is available in References 11-13. As to the ongoing recruitment of potential asbestos litigants by the legal profession, the Web sites http://mesotheliomazine.com, http://www.rarehope.com, or http://mesotheliomawise.org give great insight. However, despite any urban-legend buzz, your lungs will remain safe after you handle that 6SN7.

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