

EFFECT OF ELECTROCHEMICAL TREATMENT ON THE ACOUSTIC
PROPERTIES OF PIPES

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UDC 532.612.3

Pipes made of stainless steel, nickel, titanium, and brass having bore diameters of 4 to 20 mm were investigated. The inner pipe surfaces were subjected to anodic (steel, nickel) or cathodic (titanium, brass) polarization with current densities of 0.1 to 1 A/cm² in aqueous 0.1 to 1 N KOH solutions. The electrochemical treatment was found to raise the acoustical quality of the pipes.

For a long time musicians have attributed the quality of sound to the pipe material. This association has been questioned in recent acoustical papers, and it was demonstrated that because of their rigidity, the pipe walls emit practically no sound [1, 2]. The results of the present investigation have shown that this divergence of opinions can be explained when considering the influence of the material on the shape and size of the water drops that always condense at the pipe walls. The drops, which are up to 1 mm high, cause additional energy losses of the air vibrating in the pipe. The decrease in pressure amplitude caused by this loss attains a value of 10% for a number of overtones. In conical pipes, it is chiefly the frequency range corresponding to pressure drops [3] that is subject to the influence of moisture.

The height of liquid-phase roughness in the bore and the losses are lower the smaller the pipe's wetting angle for water. The wetting angle is a function of surface state [4], and it is generally smaller for metals than for oil-impregnated wood. It is apparently for this reason that wooden flutes have been displaced by metal flutes. By reducing the wetting angle to zero, the electrochemical treatment ensures film-type runoff of the liquid that has condensed in the pipe, which wholly eliminates the losses mentioned. Hydrophilization of the pipes with detergents (polyoxyethylene ethers, salts of perfluorinated acids) has a similar effect, but only until they have been washed away by the water. Hydrophobization of the bore walls to the contrary is less effective owing to the difference between the receding and advancing angle, which favors the retention of small water drops even on Teflon.

LITERATURE CITED

1. J. Backus, J. Acoust. Soc. Am., 36, 1881 (1964).
2. A. H. Benade, Fundamentals of Musical Acoustics, Oxford University Press, New York (1976).
3. A. Ya. Gokhshtein, Dokl. Akad. Nauk SSSR, 252, 1082 (1980).
4. A. N. Frumkin, V. S. Bagotskii, Z. A. Iofa, and B. N. Kabanov, Kinetics of Electrode Processes [in Russian], Moscow State University (1952).

Institute of Electrochemistry, Academy of Sciences of the USSR, Moscow. Translated from Elektrokimiya, Vol. 18, No. 5, p. 696, May, 1982. Original article submitted May 21, 1981.