The multiple side-branch system as a model for a corrugated pipe

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Corrugated pipes are used as flexible risers in offshore natural gas production and for vacuum cleaners. Such pipes can display whistling. As theoretical models are available to predict the aero-acoustical behaviour of closed side branches \cite{1}, we consider a row of equally spaced closed side branches along a pipe, as a model for a corrugated pipe. We consider side branches with a diameter $D$ and depth $L$ equal to the main pipe diameter, placed at a distance of three diameters from each other. For systems of 11 or 12 side branches the lowest resonance modes are reasonably well predicted by assuming $n(\lambda/2)$ standing wave modes with an effective speed of sound $c_{\text{eff}}$\cite{2}. Whistling is observed for the $n=2$ and $n=3$ modes with a pressure fluctuation amplitude $p'(\rho c_0U_0)=O(2\times10^{-2})$ similar to that observed for sharp edges corrugations in a corrugated pipe (with $\rho_0$ the fluid density, $c_0$ the speed of sound and $U_0$ the main flow velocity). The Strouhal number of these oscillations is $Sr_D=(f\cdot D)/U_0\simeq0.70$. This is higher than typical values observed for corrugated tubes \cite{3}.

References: