# DOPPLER EFFECT TRANSDUCERS

When a sound wave at a given frequency is reflected from a moving target, the frequency of the reflected or backscattered sound is different. The shift in frequency is caused by the Doppler Effect. The frequency is up-shifted if the target is moving toward the observer and down-shifted if it's moving away. The Doppler shift in frequency is proportional to the velocity of the moving target and is given by

$$f_D = 2 f_0 \frac{V \cos\theta}{C} \tag{5.21}$$

where $f_D$=Doppler shift in frequency
$f_0$=transmitted ultrasound frequency
$C$=velocity of ultrasound in the moving fluid
$\theta$=angle between velocity vector V and the transmitted ultrasonic beam

Two techniques are used in the measurement of fluid flow velocity by the Doppler technique. The continuous-wave (CW) method, as used to determine the flow velocity of slurries in a pipe, is illustrated by Fig. 5.25a.52 The transmitted CW

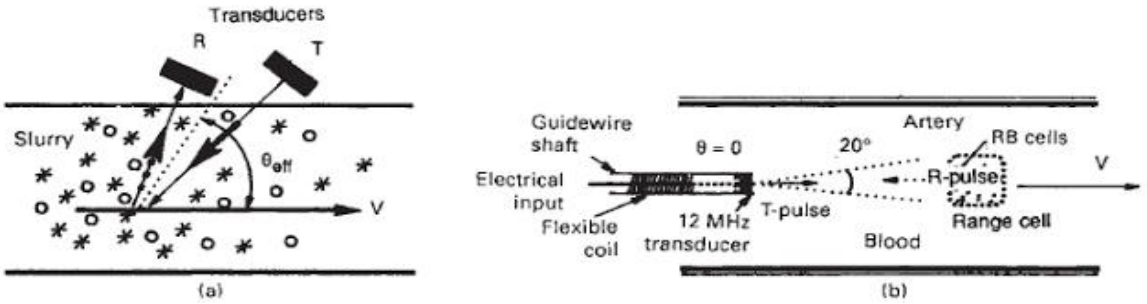

Figure 5.25 Measurement of velocity by Doppler shift. (a) Continuous-wave (CW) method. (b) Pulse-wave (PW) method gives the peak velocity.

Signal is partly reflected by the suspended particles or gas bubbles in the slurry. This backscattered signal is received by a second transducer and its output is compared with the transmitted signal. The Doppler shifted signal fD is given by Eq. 5.21. Knowing _ and f0, the velocity V can be obtained.

The second method, as used in a medical diagnostic application, is illustrated by Fig. 5.25b. A pulsed-wave (PW) signal is used to measure the blood flow velocity in a small blood sample volume or range cell localized in the bloodstream of a coronary artery. The device is constructed from a 0.45-mm-diameter, flexible and steerable guide wire with a 12-MHz transducer integrated into its tip.

The transducer transmits a sequence of 0.83-μs-duration pulses at a pulse repetition frequency of 40 kHz into the bloodstream. The range cell is located by time (range) gating the Doppler shifted backscattered signal generated by the red blood cells and received by the same transducer. This signal is compared with the transmitted signal, where as before the velocity V can be calculated using Eq. 5.21. In this case, cos ɵ=1.

Source: http://mediatoget.blogspot.in/2012/06/doppler-effect-transducers.html