Cavitation Performance Correlations

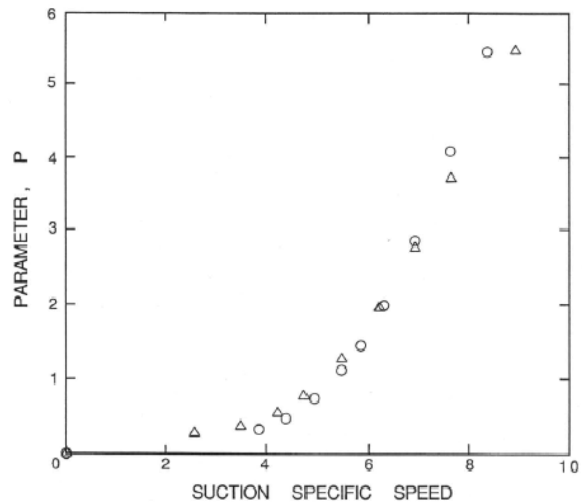

Figure 1: Some data on the cavitation head loss parameter, $P = \Delta H/NPSH$, for axial inducer pumps. The two symbols are for two different pumps.

Finally we provide brief mention of several of the purely empirical methods which are used in practice to generate estimates of the cavitation head loss in pumps. These often consist of an empirical correlation between the cavitation head loss, ΔH, the net positive suction head, $NPSH$, and the suction specific speed, S. Commonly this correlation is written as

$$\Delta H = P(S) \times NPSH \tag{Mbev1}$$

where the dimensionless parameter, $P(S)$, is established by prior experience. A typical function, $P(S)$, is presented in figure 1. Such methods can only be considered approximate; there is no fundamental reason to believe that $\Delta H/NPSH$ is a function only of the suction specific speed, S, for all pumps though it will certainly correlate with that parameter for a given pump and a given liquid at a given Reynolds number and a given temperature. A more informed approach is to select a value of the cavitation number, σ_W, which is most fundamental to the interaction of the flow and the pump blade namely

$$\sigma_W = (p_1 - p_V)/\frac{1}{2}\rho_L w_1^2 \tag{Mbev2}$$

Then, using the definition of $NPSH$ (section (Mbeb)) and the velocity triangle,

$$NPSH = \left((1+\sigma_W)v_{m1}^2 + \sigma_W \Omega^2 R_{T1}^2\right)/2g \tag{Mbev3}$$

It is interesting to observe that the estimate of the cavitation-free $NPSH$ for mixed flow pumps obtained empirically by Gongwer (1941) namely

$$\left(1.8 v_{m1}^2 + 0.23\Omega^2 R_{T1}^2\right)/2g \tag{Mbev4}$$

and his estimate of the breakdown $NPSH$ namely

$$\left(1.49 v_{m1}^2 + 0.085\Omega^2 R_{T1}^2\right)/2g \tag{Mbev5}$$

correspond quite closely to specific values of σ_W, namely $\sigma_W \approx 0.3$ and $\sigma_W \approx 0.1$ respectively.