Sparging Fe to Remove O as CO gas

$\underline{C} + \underline{O} = CO \quad K_{1873\,K} = 500$

$$\frac{n_{CO}}{n_{Ar}} = \frac{P_{CO}}{P_{Ar}} = \frac{V_{CO}}{V_{Ar}}$$

$$\frac{n_{CO}}{n_{Ar}} = \frac{P_{CO}}{P_T - P_{CO}}$$

$$n_{CO} = \frac{P_{CO}}{P - P_{CO}} n_{Ar} \qquad PV = nRT$$

$$n_{Ar} = \frac{PV}{RT} = \frac{P_T V_{Ar}}{RT}$$

$$n_{CO} = \left(\frac{P_{CO}}{P - P_{CO}} \right) \frac{P_T V_{Ar}}{RT}$$

$$dn_{CO} = \frac{P_{CO}}{P_T P_{CO}} \frac{P_T dV_{Ar}}{RT} = -M \frac{dwt\%O}{(100\%)(16)}$$

$$dV_{Ar} = -\frac{RTM(P_T - P_{CO})}{P_T P_{CO}(1600)} d(wt\%O)$$

$$dV_{Ar} = \frac{RTM(P_{CO} - P_T)}{P_T P_{CO}(1600)} d(wt\%O)$$

$$\int_O^V dV_{Ar} = \frac{RTM}{P_T 1600} \int_{O_i}^{O_f} \left(1 - \frac{P_T}{P_{CO}} \right) d(wt\%O)$$

$$V_{Ar} = \frac{RTM}{P_T 1600} \left[(wt\%O_f - wt\%O_i) + \frac{P_T}{(k)(wt\%C)} \ln \left(\frac{wt\%O_i}{wt\%O_f} \right) \right]$$

For 1 MT of 1040 Steel at 1873 K initially in equilibrium with Pco = 1atm:

V_{Ar} 1.48 L 90.0% [O]removal
V_{Ar} 60.0 L 99.0% [O]removal
V_{Ar} 123 L 99.9% [O]removal