Supporting Information

Author: Eric J. Reardon
Title: Zero-Valent Irons: Styles of Corrosion and Inorganic Control on Hydrogen Pressure Build-up
Pages: 5
Figures: 3

Supporting Information: Zero-Valent Irons: Styles of Corrosion and Inorganic Control on Hydrogen Pressure Build-up

Eric J. Reardon
Department of Earth Sciences
University of Waterloo
Waterloo, Ontario, Canada, N2L 3G1
email: ejreardo@uwaterloo.ca
phone (519) 888-4567 ext 3234
fax (519) 746-7484

Repeat Corrosion Tests - Corrosion tests on different batches of the same iron usually yield similar results. Figure 1 presents the corrected rates determined for two batches of Connelly iron. The tests were conducted three years apart. Both samples show an initial high rate, decreasing sharply and reaching a minimum between 100 and 150 h. A progressive increase in rate over the next 1000 h follows.

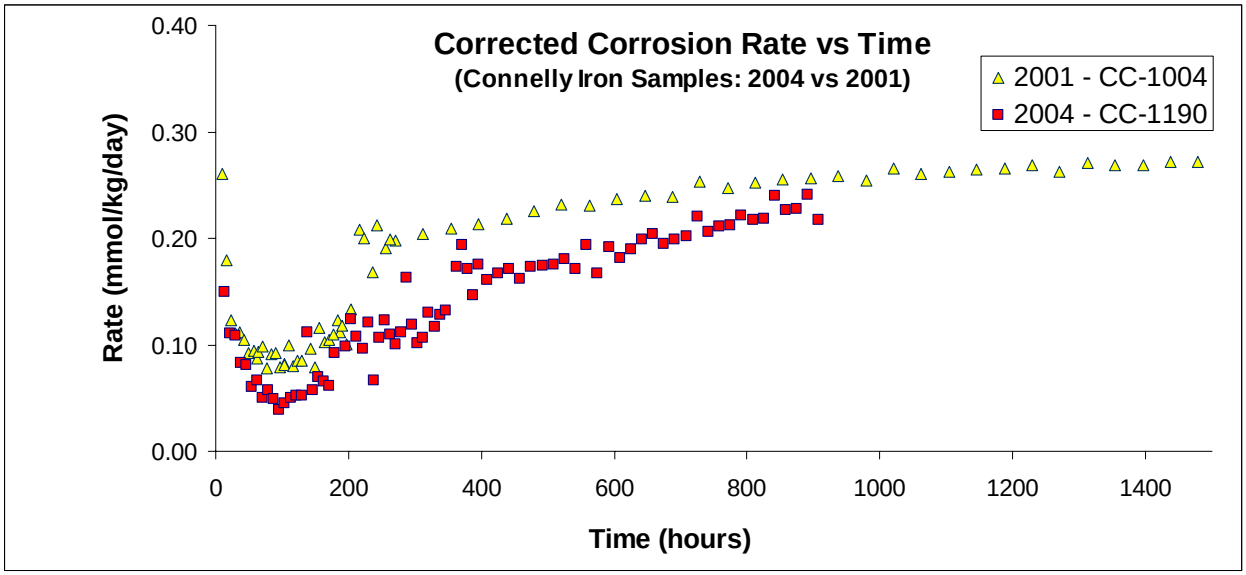
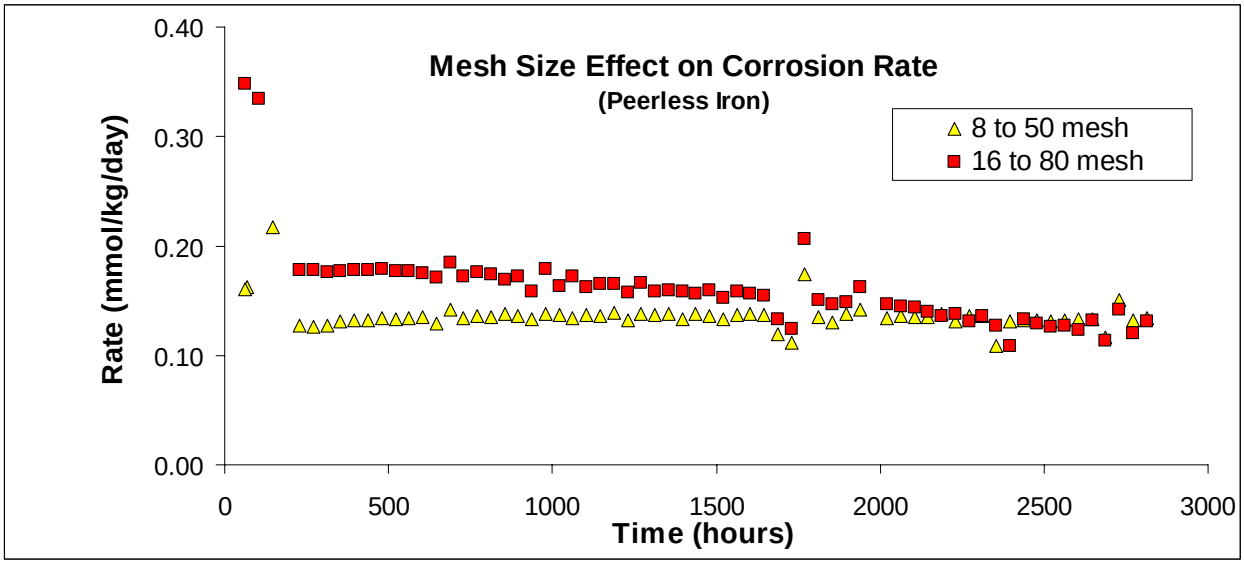
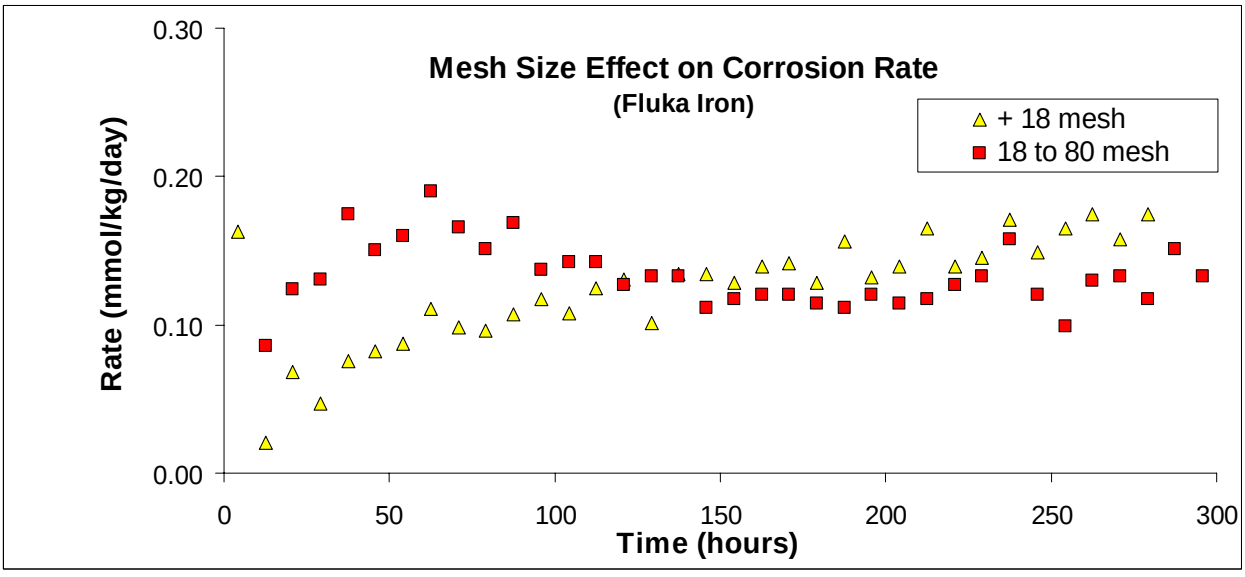


Figure 1. Comparison of the corrected corrosion rate for two different batches of Connelly iron performed in 2001 (CC-1004) and 2004 (CC-1190).

Mesh Size – It would seem reasonable to expect the specific corrosion rate of a finer mesh-size

fraction of an iron sample to be higher than a coarser grained fraction. However, many of the commercially-available irons are produced by milling and heating scrap iron and steel material to high temperatures. Depending on how these processes are conducted, it is possible that the particles of a finer-grained component would be more oxidized and potentially have a lower corrosion rate than the particles of a coarser-grained component. Figure 1 shows a comparison of the corrected corrosion rates for two mesh size fractions of three iron materials: Peerless (8 to 50 and 16 to 80 mesh), Fluka (+18 and 18 to 32 mesh) and Master Builders (+18 and -80).





.

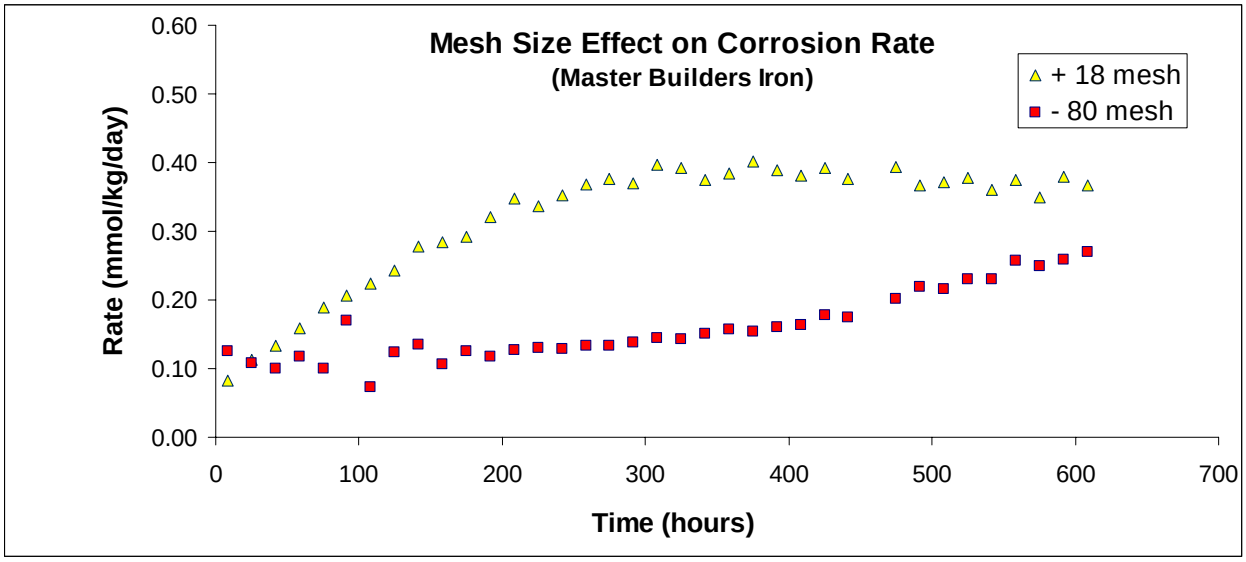


Figure 2. Comparison of corrected corrosion rate measurements for two mesh size factions of Peerless, Fluka and Master Builders irons.

For the Peerless and the Fluka irons, where the mesh sizes of the two fractions are adjacent or overlap, the corrosion rate for the finer-grained fraction is initially higher than the coarser-grained component. Because the slopes of the rates versus time are lower for the finer-grained material, the rates invert for both irons at later time. For the Master Builders samples, the grain sizes of the two samples are distinctly different (material between 18 and 80 mesh is excluded from both samples). In this instance, the corrosion rate of the finer grain size material is initially much lower than the coarser material. The rates for both size fractions increase with time. However, the finer grained material shows a lower and more sustained increase in rate.

Modelling P_{H_2} ***in PRB's*** - Assuming a wall thickness of 50 cm, cell length of 0.25 cm and using corrosion rate and k_S values determined for two commonly-used commercial irons (Connelly and Peerless) as tabulated in Table 1 of the main paper, predicted P_{H_2} values developed during flow through the PRB were calculated for a range of groundwater velocities. Other assumed properties were: a bulk porosity of 0.6 and an iron particle density of 6.7 g cm^{-3} (versus 7.87 g cm^{-3} for pure

iron). Both are representative values for Connelly and Peerless irons (1, 2). The results are shown in Figure 3.and demonstrate that P_{H_2} in excess of 100 kPa would not develop in a PRB composed of either iron at groundwater velocities in excess of 15 cm/d. Consequently, hydrogen degassing under these conditions could not occur.

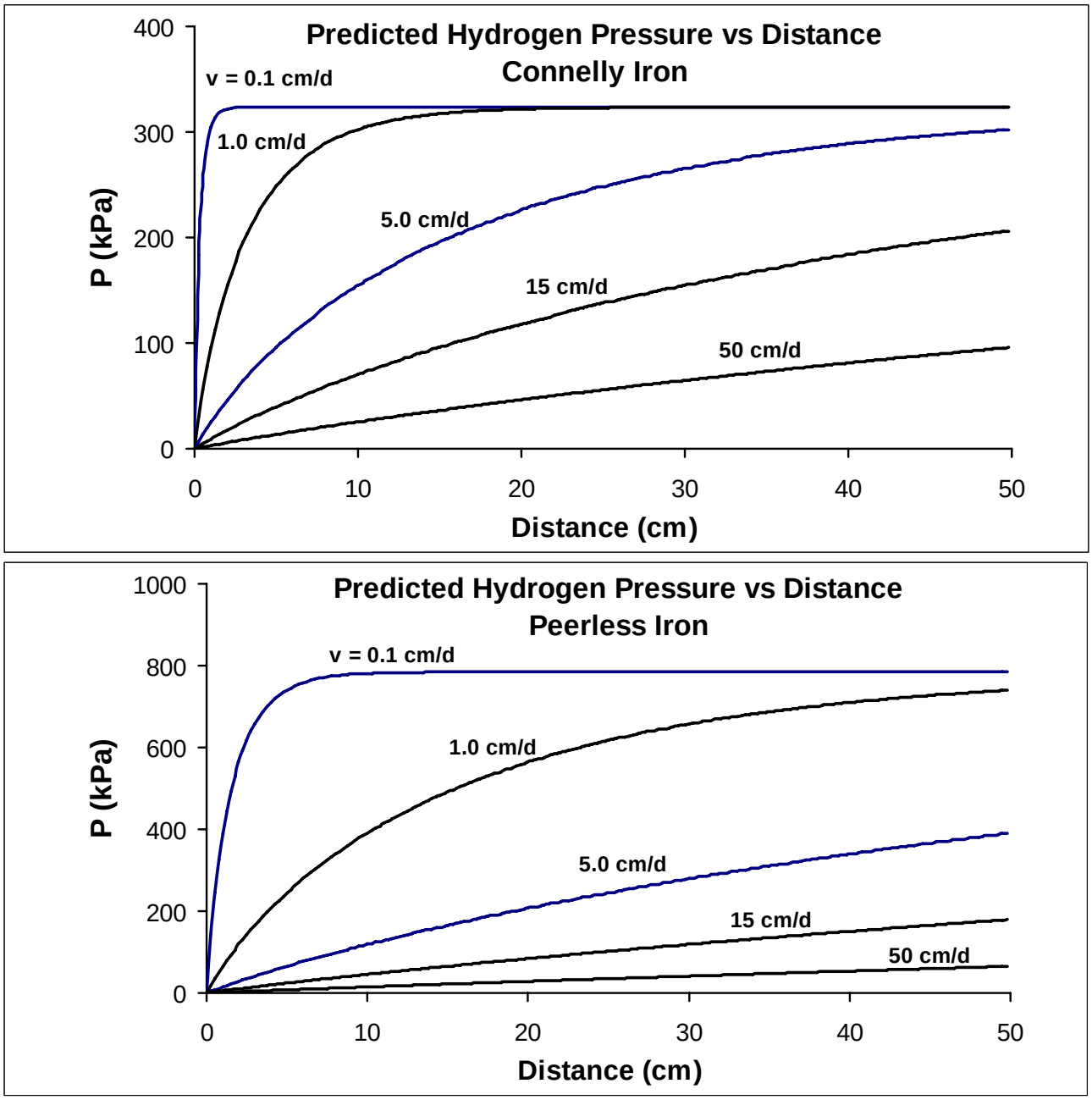


Figure 3. Predicted P_{H_2} development with distance and flow velocity through 50 cm thick PRBs of Connelly (top) and Peerless (bottom) zero-valent iron.

Literature Cited

1) Blowes, D.W.; Gillham, R.W.; Ptacek, C.J.; Puls, R.W.; Bennett, T.A.; O'Hannesin, S.F.; Bain, J.G.; Hanton-Fong C.J. An *in situ* permeable reactive barrier for the treatment of hexavalent chromium and trichloroethylene in ground water, Volume 1: Design and installation. *U.S. Environmental Protection Agency,* EPA/600/R-99/095a **1999**, 111 pp.

2) Merly, C.; Gillham, R.W.; Gui, L. Treatability by granular iron of contaminants in groundwater at the Toms River Site, New Jersey. *Feasibility Study Report (Draft), Ciba-Geigy Superfund Site, Appendix 4,* **1999,** 52 pp.