For any soil with electro osmotic characteristics (1) (ie clays and silty-clays), there will tend to be a critical maximum current density at the backfill-soil interface, above which progressive drying occurs, with corresponding increases in anode-soil resistance (2). This phenomenon, in the extreme, can lead to groundbed failure and abandonment. However, in instances where drying has been detected early enough, watering the groundbed along with current reduction, has been known to be successful for recovery.

According to Hewes(2) application of the following Guidelines resulted in stability of 90 to 95% of groundbeds in areas of high osmotic drying potential in Western Canada.

Design Maxima **Guidelines**

for minimization of electro osmotic drying in groundbeds installed in clay containing soils:

Average soil resistivity along ground bed ohm-cm		Maximum average current density on the surface of the coke breeze column		
		milli-amps / sq ft	See Ref 2	amps / sq meter
less than 1000		127		1.35
1000 - 1500		111		1.20
1500 - 2000		96		1.00
2000 - 3000		80		0.85
over 3000		64		0.70

HSCI Current Discharge Limitations:

When the natural environment tolerates CP, high silicon cast iron in impressed current cathodic protection service will operate reliably at rates of current discharge up to and beyond 33 A/sqm (3 A/sqft) without catastrophic failure.

Note that 33 A/sqm represents 8 Amps from a 50mm x 1520mm x 20kg anode. Assuming that a consumption rate of 0.5kg/A-yr applies, 8 amps equates to about 3.3 years of operating life at 65% Utilization. (Refer to website Article #24)

In practice, 20 kg high silicon iron anodes are seldom if ever driven beyond 4 Amps (16 A/sqm). Most frequently they are driven at 1.5 to 2 amps in order to function reliably in their operating environment; or at even lower discharge if electro osmotic drying is a possibility.

In contrast, Roberge (3) suggests that in marine environments high silicon cast iron anodes will operate at up to 50 A/sqm. And for DC grounding, an ABB report gives a 120A/sqm upper limit (4).

References Note: Superscripts reference Anotec Document Numbers

- (22) means reference at article end
- (#22) means Web Site Article
- (L22) means Anotec Private Library

References:

1. Anotec Article (in development): "Earth Materials: Resistivity & Electro-Osmotic Potential " (#32).

2. Hewes, F.W., "Four Phenomena Affecting Cathodic Protection and Corrosion Rates", Materials Protection September 1969 (L22) and private correspondence (L 9). For greater success, Hewes limits current density to less than 100 mA/sq ft (1.1 A/sq M) for soils of less than 1500 ohm cm resistivity. Hewes' guidelines were derived from horizontal surface beds in the soils of Alberta and Saskatchewan.

3. Lewis, T. H. Deep Anode Systems, Loresco (1997) [p 50], and in correspondence (L78), advises that an upper limit of 150 mA/sqft at the back-fill surface has prevented operational problems due to the buildup of gases or depletion of water. Lewis bases his recommendation on deep-well experience in the Southeast USA for over 25 years, as well as laboratory tests.

4. In certain jurisdictions, regulations restrict: (a) Electric field strength or current density in water, and/or (b) Electrochemical activity, such as chlorine gas generation in soil and water.

4. Roberge P.R., Web Site: www.corrosion-doctors.org/KTS/roberge.htm

5. ABB Report: "Corrosion Testing of Silicon Iron Electrodes ...as Anodes and Cathodes", 1999. (L93)