The presence of salt or high acidity speed the corrosion process, because the movement of electrons is facilitated by the extra ions present.

How can corrosion be prevented? One way, which makes use of electrochemical properties of metals, is to coat steel with zinc in a process called *galvanizing*. Zinc is more easily oxidized than iron; therefore, zinc will react before the iron is oxidized. This is called *cathodic protection*, and the more easily oxidized metal used is called a *sacrificial anode*.

The Alaskan oil pipeline, shown in **Figure 10,** is an example of steel that is cathodically protected. However, instead of coating, zinc is connected to the pipe by a wire. The zinc will oxidize before the iron in the steel does. As the zinc anode corrodes, it gives electrons to the cathode, the steel, and as the zinc anode does so, it prevents the steel from corroding. As the zinc dissolves, it needs to be replaced. As long as zinc metal that is able to corrode is present, the steel will be protected from corrosion.

FIGURE 10 The Alaskan pipeline is cathodically protected by a parallel zinc cable.

Electrical Potential

In a voltaic cell, the oxidizing agent at the cathode pulls the electrons through the wire away from the reducing agent at the anode. The "pull," or driving force on the electrons, is called the *electric potential*. Electric potential, or voltage, is expressed in units of volts (V), which is the potential energy per unit charge. Current is the movement of the electrons and is expressed in units of amperes, or amps (A).

Electrical potential is analogous to gravitational potential. Just as water flows from a position of higher gravitational potential to a position of lower gravitational potential, electrons flow from higher electric potential to lower electrical potential.

Electrode Potentials

Reconsider the voltaic cell shown in **Figure 4.** There are two electrodes, Zn and Cu. These two metals each have different tendencies for accepting electrons. *This tendency for the half-reaction of either copper or zinc to occur as a reduction half-reaction in an electrochemical cell can be quantified as a* **reduction potential.** There are two half-cells in **Figure 4:** a strip of zinc placed in a solution of $ZnSO_4$ and a strip of copper placed in a solution of $CuSO_4$. *The difference in potential between an electrode and its solution is known as* **electrode potential.** When these two half-cells are connected and the reaction begins, a difference in potential is observed between the electrodes. This potential difference, or voltage, is proportional to the energy required to move a certain electric charge between the electrodes. A voltmeter connected across the $Zn \| Cu$ voltaic cell measures a potential difference of about 1.10 V when the solution concentrations of Zn^{2+} and Cu^{2+} ions are each 1 M.

The potential difference measured across the complete voltaic cell is easily measured and equals the sum of the electrode potentials for the two half-reactions. But an individual electrode potential cannot be meas-