

Why do we need a salt bridge?

Imagine you managed to perform a reaction like this, where we just pulled electrons off zinc and put them on copper.

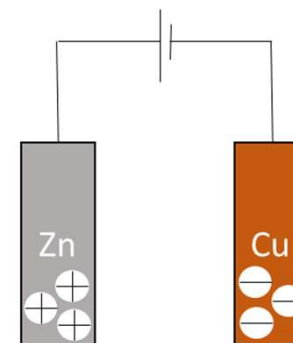
The force between the electrodes would be enormous. The reactions on both sides need to be balanced to avoid the build-up of enormous amounts of charge.

Coulombs law gives the force between two charges.

From the picture here, if 10g of copper and 10g of zinc were 10 cm away from each other and had gained (Cu) or lost (Zn) 1% of their electrons, the force between them would be 8.05×10^{16} N.

From Newton's second law:
Force = mass \times acceleration

This equates to accelerating 6 thousand billion Tesla electric cars from 0 to 60 in 2.3 seconds each.



$$Force \propto \frac{a \text{ charge} \times other \text{ charge}}{distance \text{ between them}}$$

Coulombs law states that the force between two particles increases if the charges are large and decreases when distance is large.

To do this, something that allows the transport of ions between the solutions, but not electrons is needed.

This is where the salt bridge comes in.

If you had something containing a salt, say potassium sulfate, the sulfate anions could move one way, to counter the formation of Zn^{2+} cations and the potassium could go the other way to balance the formation of SO_4 from $CuSO_4$ as copper is reduced to copper metal.

This could be as simple as soaking some filter paper in a salt solution, or it could be a membrane. It could also be a ceramic.