

## Training Event 2020 Exercise 1 – Heat Flow Calculation

## METHOD

- 1. Collect Data IN SAME UNITS
  - Hot Face (°C)
  - Ambient (°C)
  - Lining Thickness (m)
  - Lining conductivity over range of temperatures (W/mK)
  - Surface Emissivity (no unit)
  - Wind Speed (m/s)
- 2. First Estimate of Shell Temp Guess
- 3. Find Surface Heat Transfer per sq m from graph
  - For Radiation
  - For Convection
  - Add together for Total
- 4 Calculate mean temp of lining
- 5 Identify Conductivity of lining at mean temp
- 6 Calculate temp drop across lining from

 $W = k A \Delta T / \Delta x$ W from step 3 K from step 5  $\Delta T$  is (Hot Face-Shell)

 $\Delta x$  is thickness (in m not mm)

- 7 Calculate Shell Temp from Hot Face  $-\Delta T$ If this is larger than estimate, your estimate is too small, try again for a larger shell temp If this is smaller than estimate. Your estimate is too small, try again for a smaller shell temp
- 8 Repeat from Step 3 until step size of change is small

Calculate the shell temperature for a 200mm thick lining if it is made from

- 1. Insulating firebrick
- 2. Bauxite Brick

Base your calculation on a 5m/s (11mile per hour) wind speed.

The Shell is from unpainted steel with an emissivity of 0.8

The lining is in a waste gas duct carrying a dust laden gas at 1000°C



