

# Production and Combustion of Carbon Monoxide

Mix sulfuric and formic acids and you make CO plus a solution with pH<0

## Chemicals and Equipment Needed

- Concentrated H<sub>2</sub>SO<sub>4</sub> – **K2**
- 95% formic acid, HCOOH – **R2**
- Phenolphthalein (optional) – **N1**
- 125 mL Erlenmeyer flask – **P2**
- 300 mL tall beaker – **Q2**
- Stopper with short glass tube – **U**
  - To fit Erlenmeyer
- 2-10 mL graduated cylinders – **Q3**
- Small test tube
- Stoppers to fit cylinders – **U3**
- Matches – **U1**
- Gloves – **U2**
  - For instructor and for preparation

## Preparation

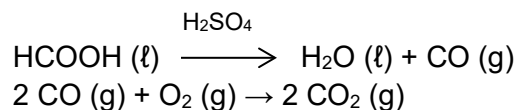
- Wearing gloves, pour 10 mL concentrated H<sub>2</sub>SO<sub>4</sub> into one graduated cylinder, and 10 mL formic acid into the other. Label, stopper, and parafilm. Place the test tube in the 300 mL beaker (to prevent it from rolling around)

## Presentation

- This demo must be performed in a room with an in-bench hood.
- Wearing gloves, pour the formic acid into the flask. Add the H<sub>2</sub>SO<sub>4</sub> and immediately insert the stopper with glass tube.
- Quickly light a match and hold it to the opening of the glass tube to ignite the evolving CO (g).
- The CO (g) burns with a blue flame. Dim the lights for a better view of the flame.
- When done, invert the test tube over the flame to extinguish it, then place the entire apparatus in/on the hood (or arrange for Demo Lab to pick it up)

## Discussion

- The reactions are:



- Note that H<sub>2</sub>SO<sub>4</sub> is not a reactant in the traditional sense. It is a dehydrating agent, removing the elements of water from formic acid. Carbon monoxide is the acid anhydride of formic acid, although it does not react directly with water.
- If desired, you can add a few drops of phenolphthalein to the flask. It is so acidic (pH<0) it turns the indicator orange.

## Clean-Up

- Unstopper flask in the hood and allow any remaining CO to dissipate. Pour solution into 1L beaker and rinse the flask. Add phenolphthalein, and the indicator turns orange. Do not freak out. Neutralize with 6 M NaOH. It will take ~100 mL to neutralize.
- When cool, pour solution down the drain with plenty of water.

## References:

- *General Chemistry*, 3<sup>rd</sup> Ed., Darrel Ebing, p. 624.
- *Tested Demonstrations in Chemistry*, 6<sup>th</sup> ed., Alyea and Dutton, p. 36.