

6.2 Sparklers (iron filings in a flame)

Subjects: Stoichiometry, limiting reactant

Description: Iron filings are sprinkled over a flame, creating sparks.

Materials (no bin):

Iron filings (located in Bin 1.0 or in the chemical storage shelves)

Cookie sheet

Meeker burner*

Matches or lighter

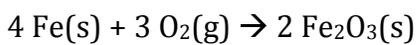
*Shared item – located in the top right-hand drawer opposite the shelves.

Procedure:

1. Place the meeker burn on the cookie tray.
2. Light the burner and sprinkle the iron filings over the flame.

Discussion:

Iron metal reacts with oxygen in the air to produce iron oxide. The reaction is given below:



The stoichiometric factor is 4 moles of iron are burned for every 3 moles of oxygen (4mol Fe/3mol O₂). If one gram of iron filings is poured onto the flame, then there is 0.0179 mole of iron (1 gram divided by 55.845 grams/mol Fe) available in the reaction. The amount of O₂ required to completely react with the iron filings is:

$$0.02 \text{ mol Fe} \times (3 \text{ mol O}_2 / 4 \text{ mol Fe}) = 0.015 \text{ mol O}_2 \times 16 \text{ g/mol O}_2 = \mathbf{0.24 \text{ gram O}_2}.$$

The iron will burn until consumed entirely producing iron oxide. There is much more O₂ available in the atmosphere than needed to consume the iron. The amount of iron oxide produced is determined by the amount of iron powder, not the amount of oxygen. Thus the iron is the limiting reactant.

Safety: Use caution when working with the burner and avoid sparks. Keep flammable materials clear of demo.

Disposal: Clean up small amount of iron oxide with wet towel and dispose in trash.

References:

1. Prof. Botch
2. J. Kotz, P. Treichel, J. Townsend; *Chemistry & Chemical Reactivity*, 7th Ed, Teachers Ed.; Thomson Brooks/Cole; 2009; p. 163