

Experiment 19: Operating a Tesla Coil

1. Objectives

- *Experience* the production and qualitative determination of ozone
- Extend understanding of ozone and its sources
- Develop technical writing skills

2. Standards

- California; Content Standard 8: Structure and Composition of the Atmosphere
 - c. Students know the location of the ozone layer in the upper atmosphere, its role in absorbing ultraviolet radiation, and the way in which this layer varies both naturally and in response to human activities.

3. Anticipatory set

- Introduce the use of and compare an exposed Potassium Iodide strip to an unexposed strip
- Display atmospheric chart showing stratosphere and troposphere
- Lead discussion on animal and human health and issues caused by too little ozone in the stratosphere and too much in the troposphere.
- Demonstrate how to hold the KI strip with the wooden tool and expose the strip to the ozone produced by the Tesla Coil

4. Teaching

- Information

Ozone is found in two different places in the atmosphere of our earth. Ozone can be either helpful or detrimental depending on where the ozone is located. A lower band of atmosphere around the earth, the troposphere, extends from the crust to between 8 and 18 kilometers above the surface. Just above this layer is the stratosphere, between 10 and 50 kilometers above the surface of earth.

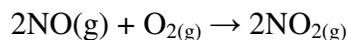
“Good ozone,” found in the stratosphere, protects us by absorbing harmful ultraviolet or UV radiation. Humans have been damaging this layer of protection by releasing CFCs, or chlorofluorocarbons, found in cleaning solutions, aerosols and refrigerants. While remaining unusually stable in the troposphere, these compounds are not directly harmful to people, but when they travel into the stratosphere high energy UV radiation breaks them down, releasing atomic chlorine. Atomic chlorine, a reactive element, attacks the ozone beginning a chain reaction of ozone destruction.

Ozone in the stratosphere protects us. Behaviors which reduce this ozone brings on an increase in skin cancers, diminishes our immune system, and causes cataracts and damages plants and trees.

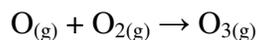
Ozone found in the troposphere, the “bad” ozone, is an air pollutant. Burning fossil fuels creates nitric oxide (NO).



Oxygen in the atmosphere mixes with this nitric oxide causing a chemical reaction producing nitrogen dioxide. Nitric oxide and nitrogen dioxide are referred to as NOx (nocks).

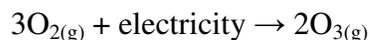


Regardless of the compound, in the presence of ultraviolet or UV radiation from the sun, oxygen is released. This oxygen is quite reactive, attaching to diatomic oxygen in the air which produces ozone.



This pollution, rising to dangerous levels, has become a significant health problem including breathing problem in people, damage to rubber and paint, and the most important cause of plant destruction and loss. In addition to car exhaust, the burning of biomass also caused an increase in ozone, which we have seen in the tropical regions of earth.

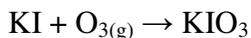
Ozone is also made during lighting, and whenever an electrical arc occurs in the presence of oxygen, like when operating a Tesla Coil!



Ozone produced in by man becomes smog, meaning it reacts with sunlight and stays in the troposphere. This ozone does not move to the stratosphere where it would be beneficial.

- Modeling
 1. Run the tesla coil, perhaps using a metal sink faucet to draw an arc.
 2. Using a wooden tool, hold a strip of potassium iodide in the arc for three minutes.

3. The strip will turn brown as it reacts to the ozone produced by the electric arc.
4. Students will also smell the pungent odor of ozone.



- Preparing the KI strips
 1. Prepare filter paper in 2-cm by 8-cm lengths.
 2. Mix a 10% solution of potassium iodide by dissolving 10g of KI into 100g of distilled water.
 3. Pour 10 mL of KI solution in a petri dish allowing the strips to soak.
 4. Remove the strips from the solution and allow them to dry overnight on a glass plate.
 5. Glue each KI strip to a tongue depressor or popsicle stick.

5. Guided practice/monitoring

- Turn on the Model One Tesla coil and operate between 60 and 75 volts using the variac
- Provide just enough arc between the coil and a metal source
- The electrical arcing will produce the ozone.
- Hold the prepared KI strip (by the wooden end) about 2 cm from the arc for 3 minutes.

6. Closure

- Ask the student to describe the odor.
- Compare an unused KI strip to one that was exposed to ozone.

7. Extensions

Assign a research project on ozone. Students might act as an investigative reporter and present using a PowerPoint slide show. Others might choose to videotape their presentation. Perhaps this topic becomes a written research report. Other extensions might relate to An Inconvenient Truth,