# W05

You have been hired as a junior food processing engineer at a leading fruit processing company. Your first task is to analyze and optimize the drying process of mango slices to produce high-quality dried mangoes, a favorite snack enjoyed by millions around the world.

The food processing company wants to produce dried mango slices using the semicylindrical dryer. The dryer's long semicylindrical shape allows for a continuous and efficient drying process.

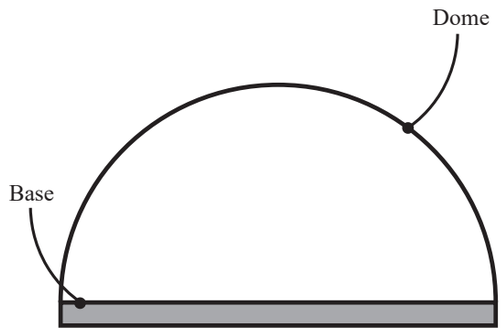


Figure 8: Cross section of the mango dryier

**Given parameters:**

- The dryer is a long, curved duct with a diameter of 1.5 meters.
- The base temperature is 370 Kelvin.
- The base emissivity is 0.5.
- The base acts as an opaque body.
- The dome temperature is 1000 Kelvin.
- The dome emissivity is 0.8.
- The dome does not reflect any radiation.
- The latent heat of vaporization for water is 2.3 MJ/kg
- $F_{B\to B} = 0$
- $F_{B\to D} = 1$
- $F_{D\to B} = \frac{2}{\pi}$
- $F_{D\to D} = 1 - \frac{2}{\pi}$

In this case study, we explore the process of drying organic materials, focusing on the production of dried mango slices. We will examine the application of a semicylindrical dryer designed to efficiently remove moisture from water-soaked mango slices while preserving their natural flavors and nutrients.

a Give the values of the emissivity, transmissivity, and reflectivity for the base and dome.

**From now on, it can be assumed that all bodies act as black bodies.** The temperatures and other parameters remain the same.

b Determine the wavelength that holds the maximum power coming off of the dome.

c Determine the net rate of heat transfer per unit length from the dome to the base.

d Determine the drying rate per unit length experienced by the wet mango slices as they pass through the semicylindrical dryer.

f Reflect on your given answer in d). Is it realistic? If not, what is the implication caused by the assumptions on the mango slices, and what about the oven itself?

g Your boss would like you to improve the drying rate by improving the design. Mention one **design improvement** and explain why this improves the drying rate.