Comsol 4.2 Tutorial

Example 2 (MASS TRANSFER)

Consider a small drop of water, which is at the bottom of a vertical tunnel diffusing in the air contained within it. In order to accelerate the diffusion process, air is blown over the top of the tunnel such that a negligible concentration of water at the top can be assumed. Strictly speaking this problem is transient; however, we can assume it as steady state to determine the concentration profile of water along the tunnel. Let us consider a spherical drop of water with a 1 mm radius as in Figure 1. To simplify the analysis, assume a perfectly cylindrical tunnel of 7.5 mm height and 2.5 mm diameter. The diffusion coefficient of water in air is 10^{-6} m^2/s.

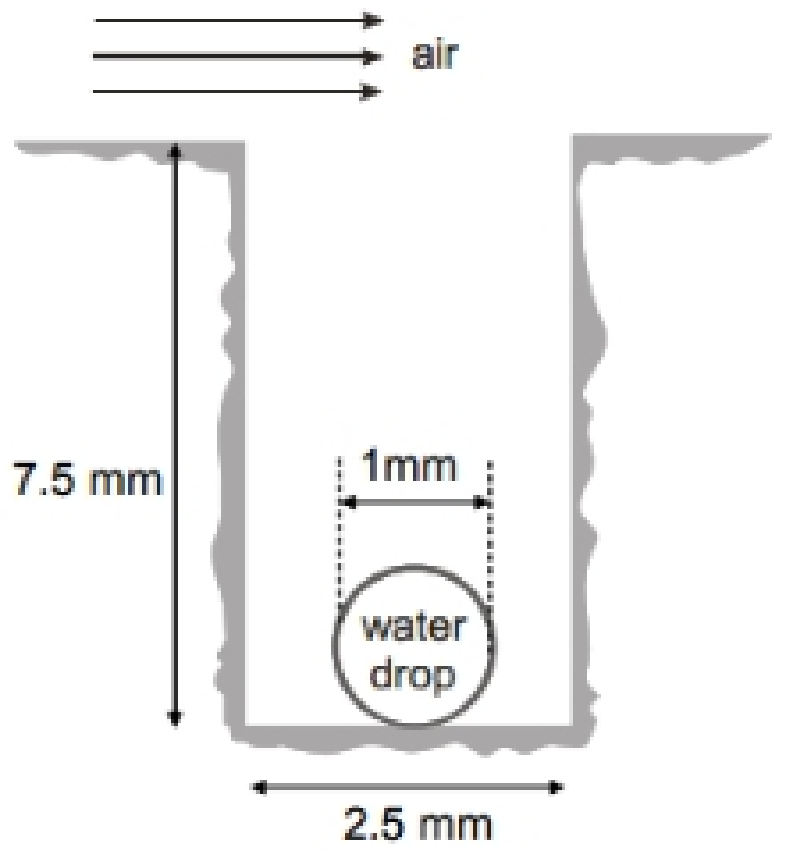


Figure 1

The region of interest is limited by the surface of the drop and the tunnel walls as shown in Figure 2.

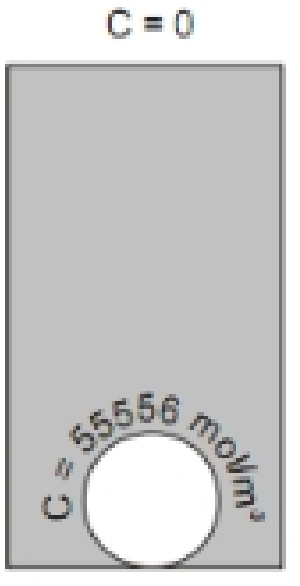
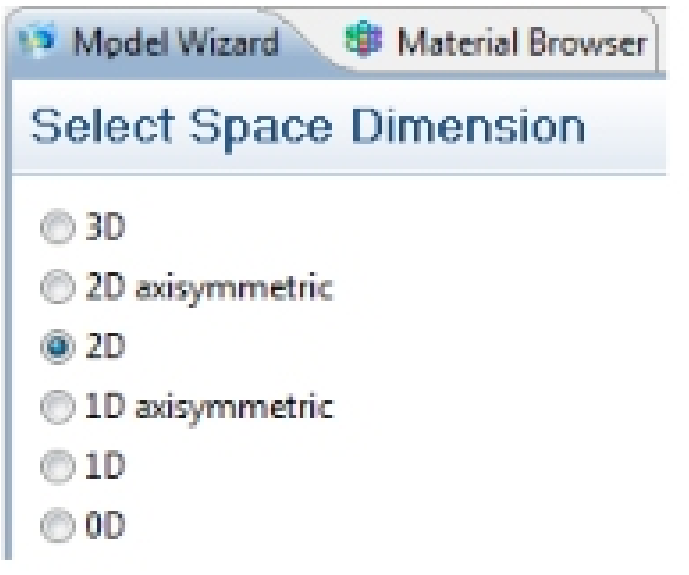


Figure 2

Start Up: Double click the Comsol 4.2 icon.

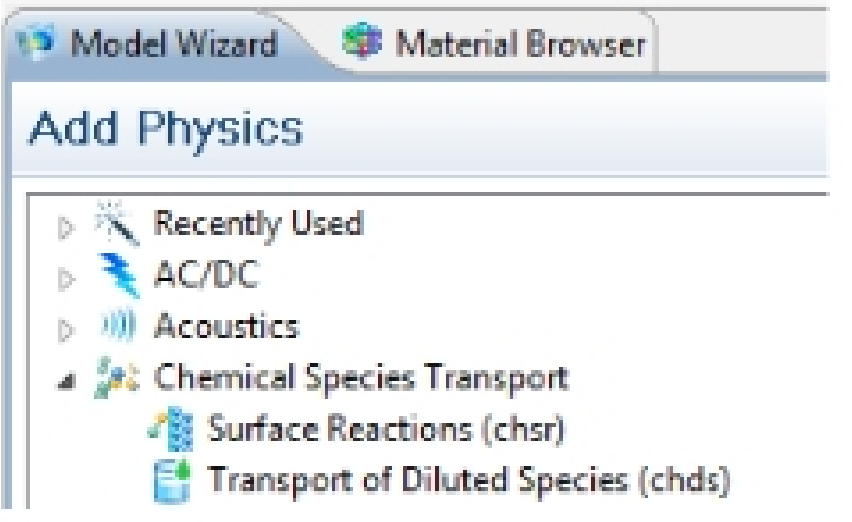
Model Wizard: The model wizard will appear in the interface; this will guide you through selecting the appropriate geometry, physics, and study type (stationary or time dependent).

This problem can be described in just 2 dimensions because of the angular symmetry. Make sure you see why this problem is 2D despite dealing with 3D objects.

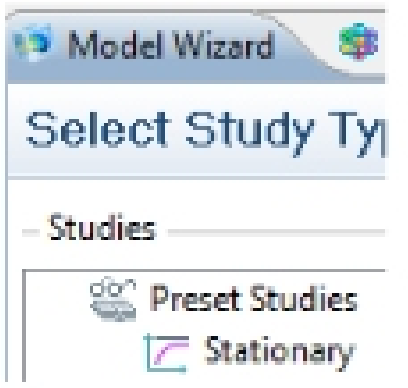


1) Select 2D and click the right facing arrow.

2) We now need to select the appropriate physics, in this case "transport of diluted species" will do the job. This can be found under the "Chemical species transport" tab. As seen to the right →



3) Finally we need to choose the study type. Because we are assuming steady state (even though this problem is inherently transient) the appropriate study type will be "stationary" To finish click the finish flag.



Geometry:

This geometry consists of both a rectangular region and a circular region. Accordingly we will need to add both a rectangle and a circle to create this geometry. Since the region we are really interested in is the region between the water droplet surface and the top of the cylindrical tunnel where water concentration is zero, we will actually subtract the circular water region from the rectangular air region using what is a called a Boolean operation. To do this:

1) Right click "geometry" and add a rectangle. Set height =7.5 [mm] and width=5 [mm]. The center of the rectangle should be at the origin.

2) Right click "geometry to add a circle. Set the radius = 1 [mm] and set the center position to x=0 y=-2.75 [mm]. After these two steps your geometry should look like the one below.