

Imacc Sample Conditioning System

The Imacc sample conditioning system is used to dry and optionally CO₂ scrub a sample before admitting it to a cell for analysis. It requires only oil-free compressed air at 45 to 100 psig and 115v power to operate. Sample conditioning provides substantial improvement in detection limits and data accuracy by removing the interferences of H₂O and CO₂ which effect some compounds in the infrared (IR). Water removal will typically improve the data for most analytes because water is ubiquitous in the infrared although its intensity varies significantly from region to region. By contrast, CO₂ absorbs in only discrete regions of the IR so it effects only certain compounds. One very important group of compounds influenced by CO₂ are aromatic compounds like Benzene, Toluene, and Xylene. Removal of CO₂ will substantially improve the detection for these compounds. The Imacc sample conditioning system can be configured to dry the sample only or to dry and CO₂ scrub it.

The Imacc sample conditioning system is shown in figure 1 below. The drying is done with a Nafion[®] semi-permeable membrane drier, selective to water, while the CO₂ scrubbing is performed with a custom NaOH or Soda Lime filter. The Nafion drier consists of 200 capillaries through which the sample is drawn. Dry air is passed around these capillaries and water selectively passes through the walls of the capillaries to be drawn away with the dry counter-flow air. The degree of drying is dictated by the dew point of the counter-flow air and the flow rate of the sample. Typically, for flows below

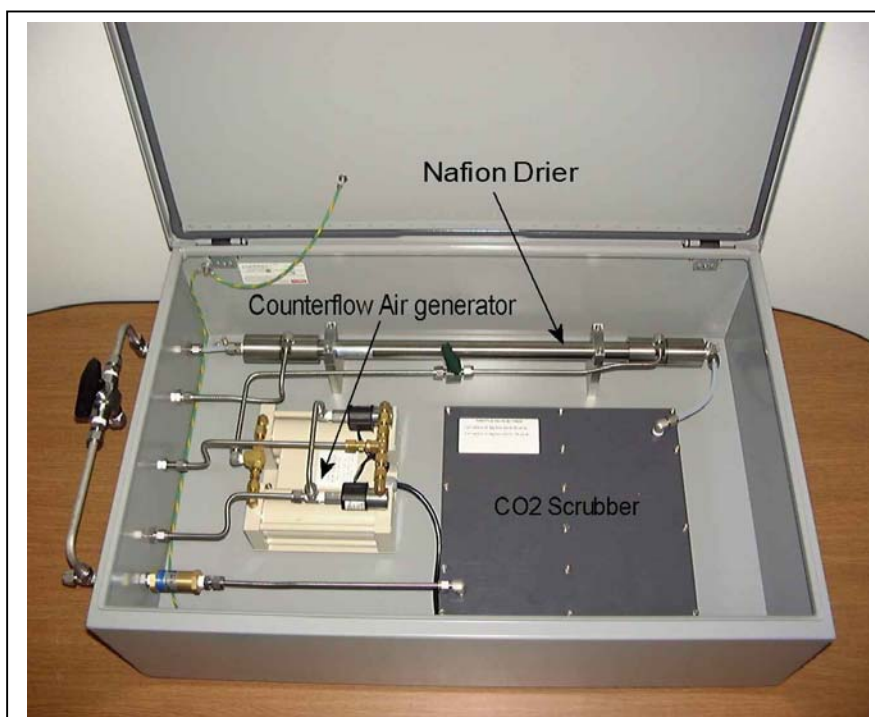
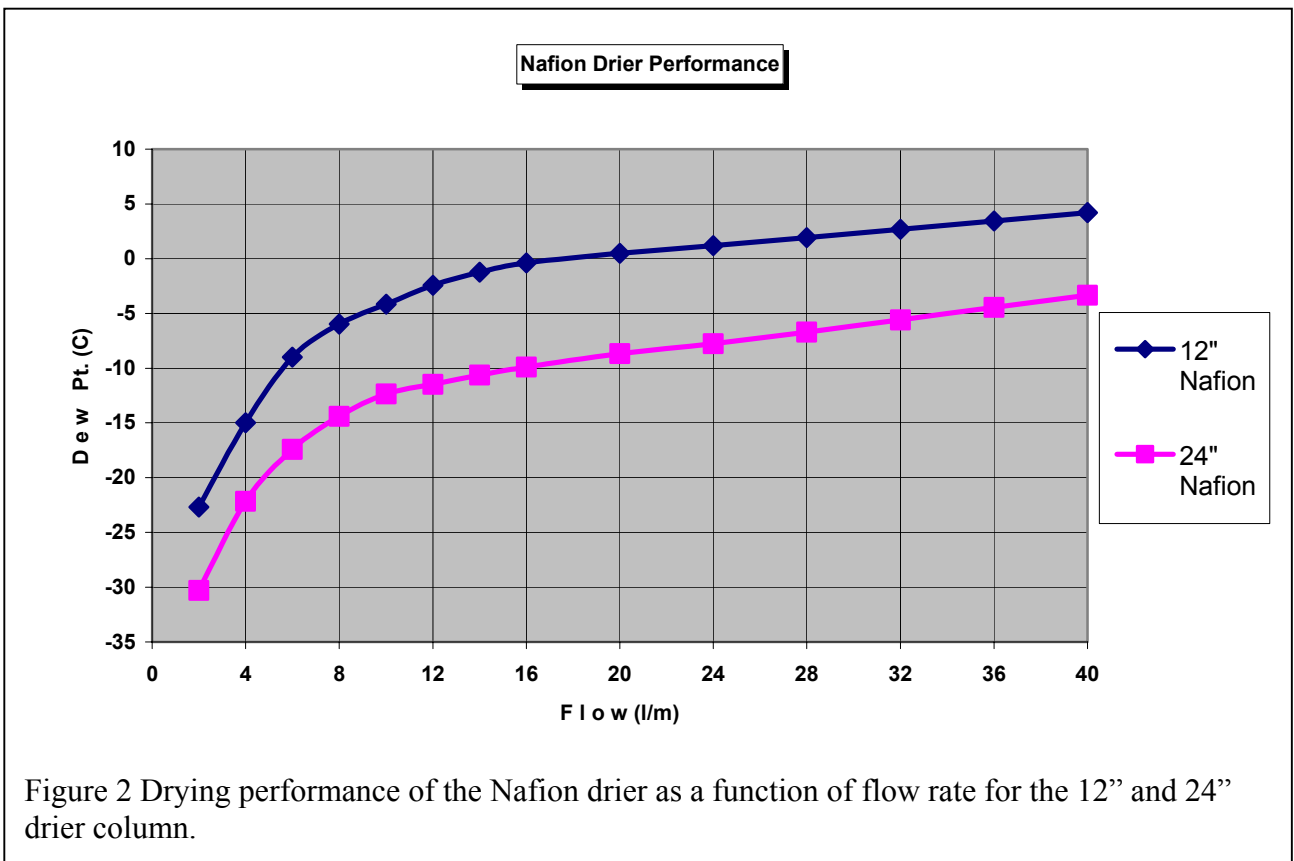


Figure 1 The Imacc Sample conditioning system showing the Nafion drier, the CO₂ scrubber, and the air generator for counter-flow in the Nafion.

40 l/m the counter-flow air generator can produce air with a dew point on the order of -40°C . For best results, the counter-flow air should be maintained at a flow rate through the Nafion of about two to three times the sample flow.

The performance of the Nafion drier itself is shown in Figure 2 as a function of flow rate. Data is shown for both the 12" and 24" driers. The normal Imacc scrubber/drier uses the 24" column. This plot assumes that the counter flow air has a dew point below the lowest dew point shown and that this counter-flow is maintained at twice the sample flow. For a sample flow of 8 liters per minute this would provide drying to about -15°C . This is on the order of 1800 ppm of water. If lower dew points are required longer or parallel driers can be used.



The CO_2 scrubber is milled from a solid PVC block. It has an internal serpentine path which is filled with NaOH or soda lime pellets. The serpentine path causes the air to traverse the box some seven times before escaping. This increases the exposure to the pellets and provides maximum scrubbing.

The scrubber itself is placed down stream of the Nafion drier to prevent the NaOH or soda lime from being exhausted by water. Typically air with 300 to 400 ppm of CO_2 will be scrubbed to less than 1 ppm. with a soda lime fill. This mixture will also last about

four weeks with continuous air flow. The scrubber does remove all acid gases and any other compounds that will react with the NaOH or soda lime. As a result it is normally used only when required to monitor gases like Benzene which have high CO₂ interference and which pass through the scrubber with little loss.

Nafion driers have not been extensively tested for propagation losses. However, current data indicates that many compounds are totally retained while other show slight loss. The Table below shows the currently information and the losses observed.

Table 1
Compounds and Their Observed Losses For The Nafion Drier*

Compounds with No Observed Loss	
Atmospheric gases N ₂ , O ₂ , H ₂ , Ar, He	Hydrocarbons All simple hydrocarbons
Oxides CO, CO ₂ , SO ₂ , SO ₃ , NO, NO ₂	Toxic gases HCN, COCl ₂ , NOCl
Halogens Cl ₂ , F ₂ , HCl, HF, HBr, Fluorocarbons	Organics Aldehydes, THF, Cyanides, Esters
Sulfur Compounds H ₂ S, COS, Mercaptins	Inorganic acids HNO ₃ , H ₂ SO ₄
Compounds with Some Loss	
Polar Organics	Others
Alcohols, Organic acids, Ketones	NH ₃ , Amines

* Data from Perma Pure, Inc. Toms River, NJ