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Dew condensation on polyacrylamide gels

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Polyacrilamide gels are known to absorb liquid water by a very large amount. Static or osmotic pressure can then be used to recover water. Once mixed with soil in arid regions such swollen gels can give water to the young plants to help the roots to reach the deep, humid soil layers. There is an obvious interest to swell the gels with water obtained at the place where they have to be used. In this aspect, collecting water from air by dew condensation is very appealing. This study thus addresses the conditions where the gels can collect dew water.

For this purpose a setup was designed consisting of a 10 cm diameter silicon plate, either bare or filled of a gel layer, and cooled by a Peltier element. The Peltier element is hold by a motorized support which moves it from an upper position, where contact with the plate is ensured, to a lower position, where the plate, suspended by holders attached to a balance, can be weighted. Experiments were performed with Aquabsorb 3005, medium-size (0.3 - 1 mm), a granular polyacrylamide manufactured by SNF Floeger, a cross-linked copolymer of acrylamide and potassium. A layer of grains with thickness about 1.5 mm is deposited on the plate. The device is placed in a climatic chamber with controlled air temperature (20°C) and relative humidity (50%), yielding a dew point temperature Td=9.3 °C.

Three kinds of experiments were performed. With Tp the plate temperature, case (i) is concerned with the reference case where the bare Si substrate is at Tp=Td-4°C. It corresponds to a condensation rate of 0.09 mm/h. Case (ii) corresponds to condensation with gel below the dew point at also Tp=Td-4°C. It sees a constant increases of mass, with slope 1.5 kg/kg water mass per gel mass per h. or 0.14 mm/h., with some weak deviations from linearity at late times corresponding to the fact that gel swelling has to diminish until it reaches its maximum. Case (iii) is concerned with water adsorption above the dew point (Tp=Td+4°C). Saturation occurs with a typical time of 250 min., giving saturation at 0.2 mm (0.2 kg/kg) after about 24h.

Such preliminary experiments thus show that gels, when cooled below the dew point temperature, can condense water at a larger rate than a bare substrate. In addition, when gel temperature is above the dew point temperature, water adsorption still occurs. Further studies will proceed by using different gels placed in different humid air conditions and plate temperature to determine the best gel candidates to harvest atmospheric moisture.