Electrospinning around the world

NanoQuEST

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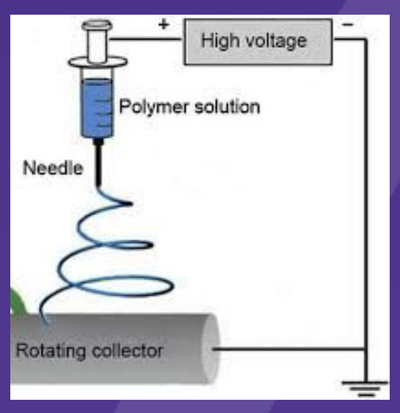
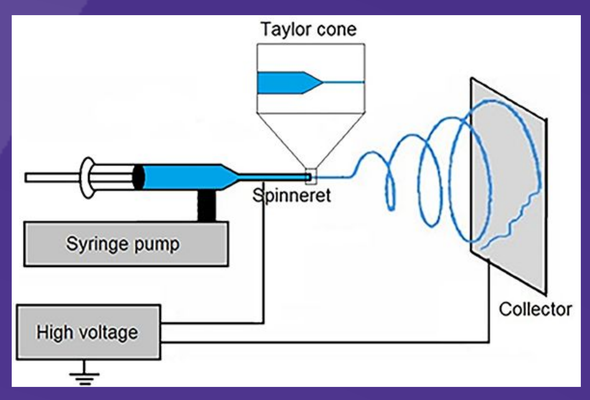
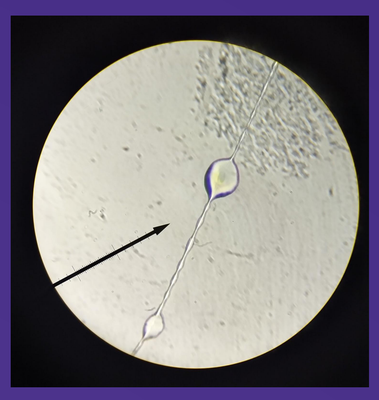
Our Set Up

Our setup includes a grounded copper collection plate coated in aluminium which is perpendicular to the needle. We then use a high voltage power supply of 0-10 kV at 30 mA to create a circuit which allows us to pump solutions. Our syringe pump usually works at an extrusion rate of 0.50 mlh $^{-1}$ and we use 19G needles.

With this set up we extrude our solutions (using either polyethylene oxide and water, or dimethyl sulfoxide (DMSO) and 1-ethyl-3-methylimidazolium diethyl phosphate with alpha-cellulose) and attempt to create nanofibres. This works by generating an electrical potential across the syringe needle plus the solution inside and the collection plate. Each liquid droplet at the end of the needle is charged and therefore will jump across to the plate producing nanofibers as the jet is stretched and elongated.



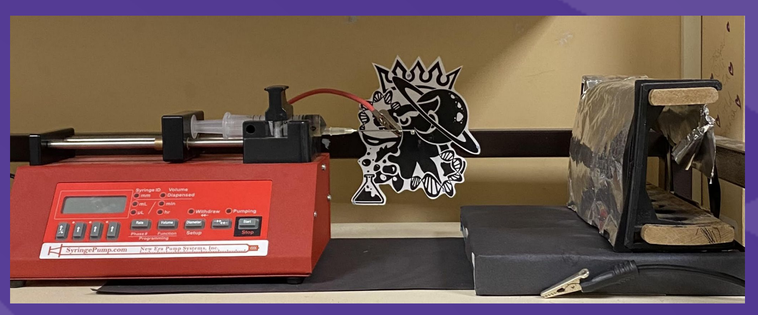




International Collaboration

We also have opportunity to be in an ongoing collaborative research project with North Penn High School, USA. We hold online meetings where we share our different methods of collecting data and the equipment we use to electrospin our solutions into nanofibers. Currently our research includes conducting parallel experiments with identical equipment and materials and looking into how the data differs due to the effects of the surrounding environment.

In addition to this collaboration we are in contact with Dr Marcus Johns from University of British Columbia who has been aiding us with our research on ageing cellulose.



Future Research

Acetate Solution Recovery - recover the acetate from our past ionic solutions using a rotary evaporator

Water Content Research - Find the optimal water uptake for producing electrospun fibres.

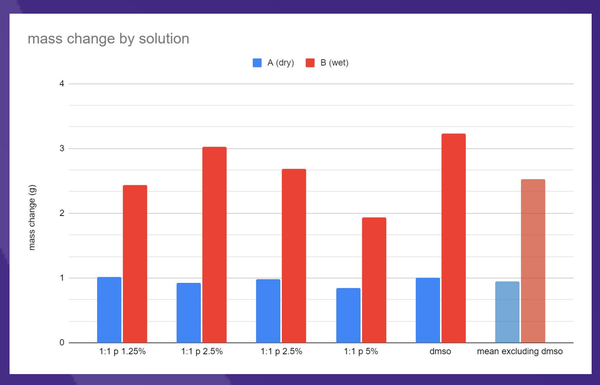
Polyox Parameter Testing - Test 900K polyox to find optimal conditions to compare with North Penn polyox.

Viscosity Investigations - Investigate how viscosity affect the ability of our solutions to spin fibres.

Ageing

We noticed that how likely our cellulose solutions are to spin is affected by the age of the solutions. Previous experimentation revealed that this is because of the hydrophilic DMSO absorbing water vapour. We then set out to test where the most advantageous storage location is to keep the solutions at their optimal parameters for as long as possible.

Previous experimentation results



Method

Our method for our most recent experiment on how Humidity Affects Mass Gain of DMSO

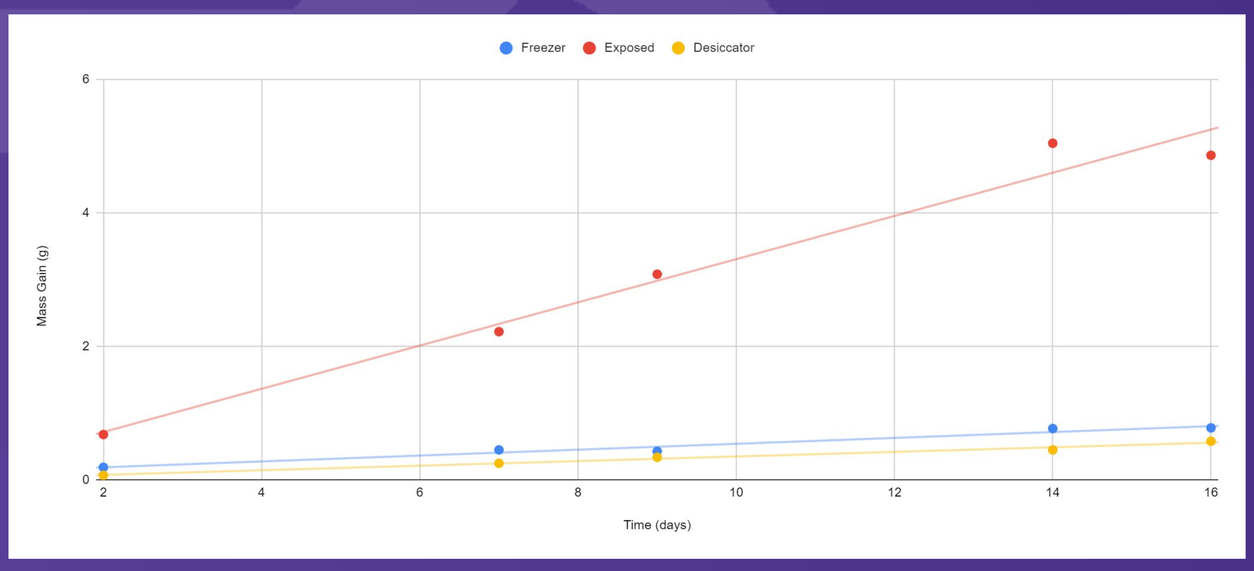
- Poured 25ml of DMSO into 15 beakers
- Stored the beakers in 3 separate locations with 5 beakers in each
  - Freezer of humidity 30% at -15℃ *
  - Exposed lab of humidity 61.0% at 19.4℃
  - Desiccators of humidity 34.9% at 21.1℃

* ± 10% and ± 5℃

- Calculated the mass change of a solution from each location
- Found the rate of change

Results

From the graph below we have discovered that while the desiccator has the minimal amount of mass gain, storing solutions in a freezer has a similar rate of mass gain and is 1/10th of the rate of gain than an exposed lab environment such as a cupboard. This provides us with a more viable method of storing our cellulose solutions.



QuEST at Queen Elizabeth's Grammar School

IRIS

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