AUCKLAND BIOENGINEERING INSTITUTE
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Jet Injection for Genetic Modification

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Introduction

Jet injection is a contactless and needleless method that provides an alternative to the traditional needle injection. The device used is capable of small volumes with an maximum of approximately 53 µL and uses an orifice diameter of 130 µm. This could be useful way of introducing bioactive molecules into plants or plant tissue.

Aim

To confirm the viability of this device for injecting enzyme-substrate solutions and to determine if proteins passed through the device retain their activity.

Method

An enzyme limiting solution was used to be able to determine the effect of the injection method on

Triplicates of two full volume injections are performed at different currents supplied to the motor. The speed of the motor is controlled by the current supplied from an amplifier which is set in LabView.

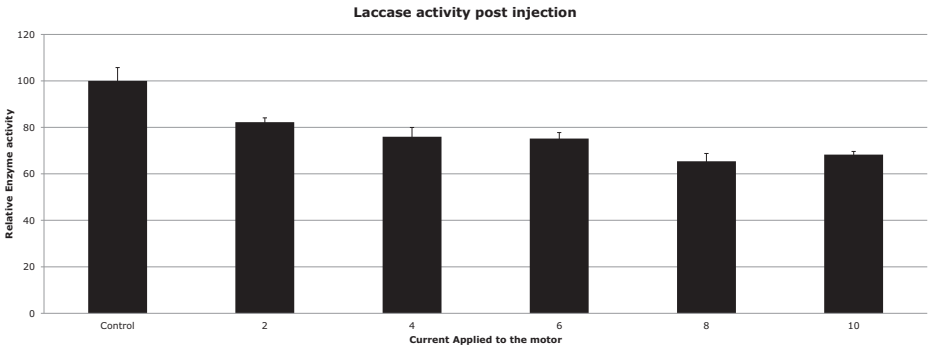
A linear displacement sensor is built into the device, and LabView is used to record the displacement of the motor. The displacement files are then analysed in MATLAB to produce values of interest such as the total time of injection and the velocity.

The enzyme substrate solution are collected in falcon tubes and assayed to collect data on the activity of the enzyme post injection. The tubes were weighed after collection of the samples and again after being cleaned and dried.

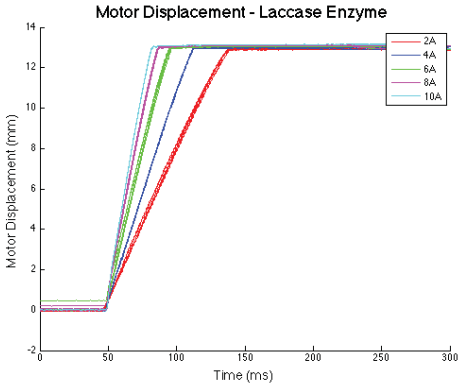
Results

Fine spray occurs after injection and can be seen on the walls of the falcon tubes. A froth is produced immediately after injection in the solution, this is most likely due the force of being pushed through the injector, this froth quickly dissipates. The enzyme Laccase shows reduced activity after being fired through the injector.

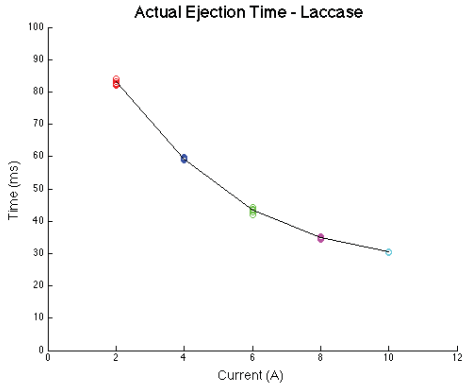
The volume of injectate recovered was reduced and appeared to be affected more by increasing the current supplied to the motor. The enzyme solution was also observed to be leaking between the orifice adapter and syringe. Increasing the amount of thread tape in this connection improved the volume recovery. Another potential source of volume loss is aerosol formation after injection into the falcon tubes.



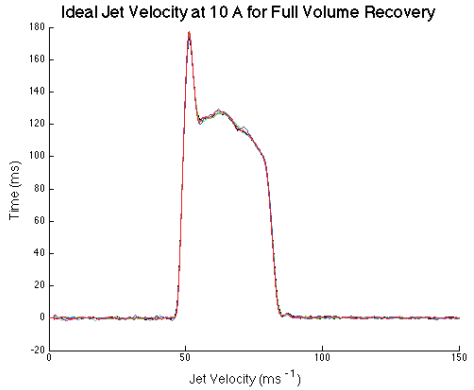
The relative activity of the Laccase enzyme after being used the device.



Displacement traces recorded in LabView from the linear displacement sensor



Total time of injection calculated in MATLAB from the displacement recordings



The ideal jet velocity of the injections at 10 A assuming 100% volume is ejected through the orifice. Calculated from the 10 A displacement traces.

Conclusions

Results for enzyme injection through the device shows potential for this method to have an application in micro volume injections but the current device needs to be developed further for improved efficiency and control.

More experimentation should also be done to determine the repeatability of the method and it's suitability for use in gene modification applications.

Further Work

Experiments that assess the effect of this device on enzymes capable of modifying the genome will add to the current data. In addition, determining a suitable plant tissue for injection is essential for future work.

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