dragonfly® discovery: Pioneering Sustainable Liquid Handling in the Modern Laboratory

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dragonfly discovery delivers multi-channel non-contact reagent dispensing using positive displacement syringes

Overview

In this poster, we highlight the significant role that dragonfly discovery plays in reducing the environmental impact of liquid handling workflows.

In our first case study, dragonfly discovery demonstrates a reduction in plastic pipette tip usage by over 99% compared to traditional air displacement pipetting systems when performing a 3456-run enzymatic assay operated by 6-factor space-filling Design of Experiment (DoE). In Next-Generation Sequencing (NGS) library preparation workflows, such as the NEBNext® Ultra™ II FS DNA Library prep kit presented in our second case study, dragonfly discovery achieves a plastic reduction of over 50%.

Case study 1: Enzymatic assay operated by DoE

Protocol highlights

- In this case study, we combine the speed and accuracy of dragonfly discovery with the flexible planning and data aggregation capabilities of Synthace to characterize a spectrophotometric enzymatic assay.
- A 384-run space-filling design was used to explore the 6 factors of interest for a spectrophotometric assay: Concentrations (substrate A, substrate B and additive), buffer type, buffer pH and temperature.
- The 6-factor space-filling DoE required 3,456 runs in total for two sets of triplicate 384 runs and the corresponding blanks. This amounts to 20,745 liquid handling steps (2,305 for each of nine 384-well plates).
- 20 dragonfly discovery tips were used in total to execute all 3,456 runs, including 6 tips for the active component that were not able to be re-used between replicates and 14 tips for the other liquid components that were re-used. Simulations using an optimized planner of the same experimental setup in Synthace showed that 25,371 tips from 66 384-tip boxes would have been required if performed by a traditional pipetting robot.

Results

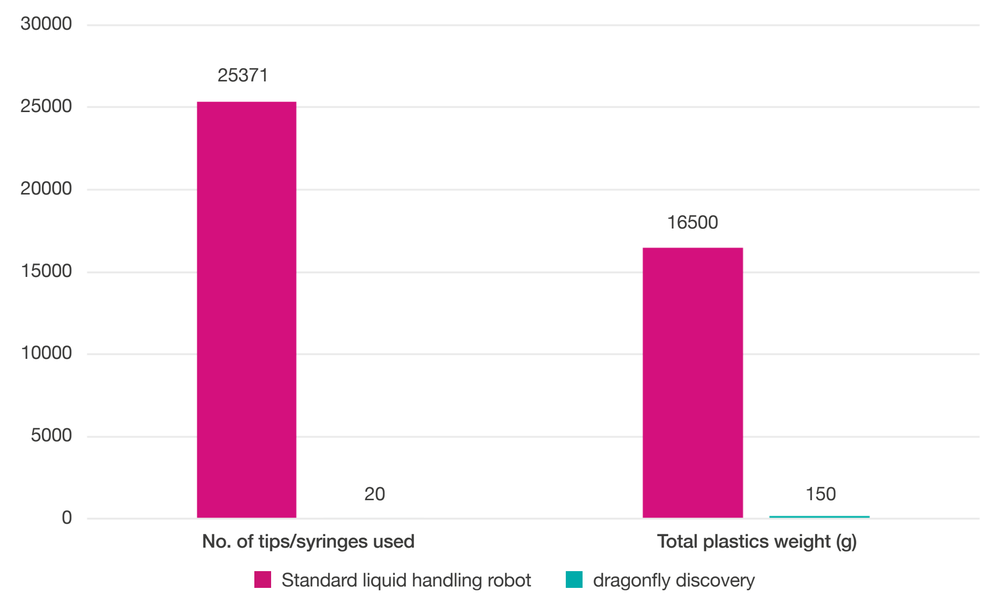

Figure 1. Comparison of plastic consumables required to perform the spectrophotometric enzymatic assay characterization using a standard liquid handling robot vs dragonfly discovery non-contact dispenser (approximate weights used in calculations: 20µL 384 tip rack = 250g; dragonfly discovery 10 syringe tray = 75g)

*66 384-tip racks are required to get 25,371 tips

Figure 2. Environmental impact of performing an enzymatic assay DoE using a standard air-displacement liquid handling robot vs dragonfly discovery non-contact reagent dispenser. Production of 1kg of polypropylene creates around 1.4 - 2.41 kg of CO_2 emissions

(https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8587715/).

Case study 2: NEBNext® Ultra™ II FS DNA Library prep for NGS

Protocol highlights

- NGS library preparation is a particularly laborious procedure, requiring a huge number of pipetting steps over several hours. This makes it a significant contributor of single-use plastics and a promising candidate for laboratories looking to improve their sustainability.
- Typically, each sample requires 20-55 pipetting steps, which equates to ~2,000-5,500 tips per full 96-well plate and 20,000-55,000 tips per 1,000-sample project.
- As an example, the NEBNext Ultra II FS DNA Library prep workflow consists of 23 liquid handling steps, out of which 13 (56%) are bulk reagent additions (as shown in Figure 3).
- Automating these steps using a typical pipetting robot reduces the hands-on time and person-to-person and day-to-day variability but produces just as much plastic waste as a manual process.
- Replacing all pipette-driven reagent aliquoting steps with dragonfly discovery non-contact dispensing not only further accelerates the reaction setup, but also decreases the number of single-use plastic tips by at least 50%.

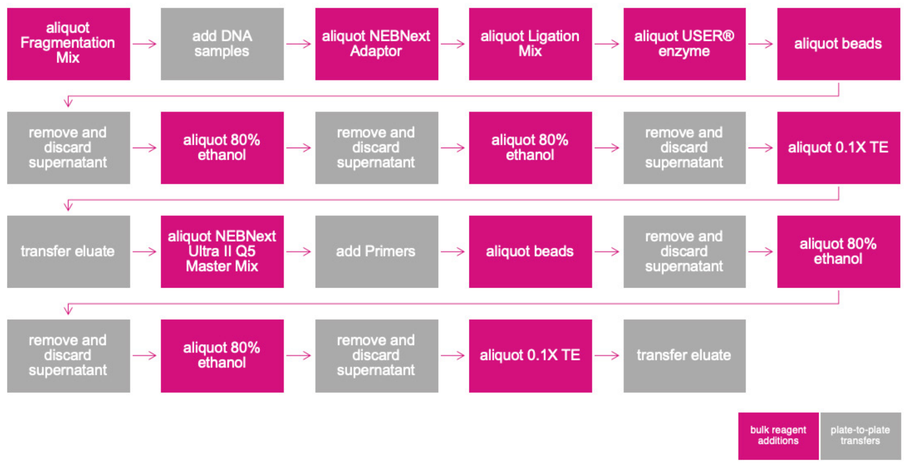

Figure 3: Schematic diagram showing the liquid handling steps required to execute the NEBNext® Ultra™ II FS DNA Library prep protocol.

Results

Figure 4. Comparison of a tip usage and single-use plastic waste weight in the NEBNext® Ultra™ II FS DNA 384-sample workflow using a standard liquid handling robot only vs using dragonfly discovery non-contact dispenser to perform bulk reagent addition steps (approximate weights used in calculations: 20µL 384 tip rack = 250g; dragonfly discovery 10 syringe tray = 75g)

*21 384-tip racks are required to get 8,096 tips

Conclusions

- This work demonstrates that dragonfly discovery non-contact liquid dispensing can significantly reduce the environmental impact of liquid handling workflows.
- In a 3456-run enzymatic assay characterization using DoE, dragonfly discovery reduces plastic consumables usage by over 99% in comparison to traditional air displacement pipetting systems, i.e. reducing plastic waste by approx. 16kg.
- In the NEBNext® Ultra™ II FS DNA Library prep for NGS workflow, the use of dragonfly discovery to perform bulk reagent dispensing reduces plastic consumables usage by over 50%, i.e. reducing plastic waste by approx. 2.5kg.

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