Reduction of Plastic Waste Through the Use of Automated Pipette Tip Washing

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Abstract
Operations of scientific laboratories are largely built upon the accepted use of disposable products. Every day, massive amounts of pipette tips, microplates, cell flasks, and much more are consumed and thrown away after a single use only to be incinerated or tossed into a landfill, in turn, negatively impacting our environment. Ideally, we would minimize this detrimental effect by reducing the amount of waste generated from the assays conducted in our labs while maintaining the integrity of the data produced. Over the last 7 years, the National Center for Advancing Translational Sciences (NCATS) has been working towards minimizing waste from our high throughput screening systems through in-house process adjustments, as well as by evaluating and integrating eco-friendly peripheral devices into our various screening platforms. An example is a pipette tip washer with the capability of cleaning and drying a large variety of pipette tip sizes and brands found in most lab settings. To this end, we have integrated the Grenova TipNovus Mini onto our Wako Automation cherry picking robotic platform in order to automate 384-pipette-tip washing which has helped us to dramatically reduce the waste being generated during siRNA screening library preparation and assay-ready plate stamping in an efficient and cost-effective manner. Comparing siRNA screening results from assay-ready plates prepared using new versus washed pipette tips containing the same samples and run in the same assay demonstrates that the data are unaffected by the use of washed pipette tips. Incorporating pipette tip washing into the workflow allows us to maximize the runtime of this robotic system and increases its functionality, thus allowing us to adopt the same methodology of tip washing to other processes. Integration of this pipette tip washer has helped us to take a significant step towards operating in a more environmentally conscious manner while continuing to produce reliable high-quality data.

Integration Solutions
• User will select between landscape and portrait handling depending on the desired labware and process
• The URS gripper fingers were modified to allow pick and place of the tip racks into the TipNovus Mini wash and dry drawers. Fingers were angled down to account for the height of the drawer face plate and extenders were added to fit into the 4mm space between either side of the tip box and the adapter
• Storage carousel was modified to allow the XPeel to sit closer to the URS arm since the position was outside of the robot work envelope with the new gripper finger design
• Liconic plate shovels were modified to be wider in order to handle the nested styled tip boxes more reliably with the added stability
• Wash and dry drawers treated as individual devices to allow continuous washing and drying for a higher throughput

Future improvements planned
• Proximity sensors in conjunction with Beckhoff I/O will be added to accurately determine if the TipNovus Mini drawers are fully open to avoid crashes
• TipNovus Mini adapters will be redesigned using a material more amenable to automation

Validation Methods
1. 2 ul siRNAs transferred from source 384 library plates to destination assay plates
2. Assay-ready plates stored at -80°C until day of use then thawed and centrifuged
3. 2 ul negative and positive siRNA controls added into column 23 and 24 respectively (excluding “striped” experiment)
4. 20 ul of serum free media including 0.03 ul RNAiMAX transfection reagent dispensed into each well
5. Incubation for 30 minutes at room temperature
6. 20 ul cell media dispensed at a concentration of 650 cell/well
7. Incubation for 96 hours at 37°C, 95% humidity and 5% CO2
8. 20 ul of CellTiter Glo dispensed into each well
9. Incubation for 30 minutes at room temperature
10. Luminescence data collected on multimode plate reader for viability

Results
Source plates were prepared containing alternating negative and positive siRNA controls with columns 23 and 24 left empty. Tips cleaned with the TipNovus Mini were used to transfer from the “striped” source plate to the assay plate after which the tips were washed again. These re-washed tips were used to transfer from the same “striped” source plate but with the orientation reversed. Validation protocol was then followed.

Conclusions
There is natural synergy in integrating a tip washing device on a platform that utilizes tips to perform cherry pick operations. There is also an improvement in overall system utilization now that the platform can be used both for cherry picking and tip washing operations for a variety of tip type from multichannel pipette systems throughout the center. Data generated using washed tips from the pipette tip washer is of the same quality as data generated using fresh sterile tips directly from the manufacturer. Integration of the tip washer allows for the reduction of material waste while still producing reliable high-quality data and increasing the overall utility of one of our automated platforms.

Wako Automation Cherry Pick System

Automated Cleaning Process
1. Tip racks are initially housed in the Liconic labware storage carousel
2. URS robotic arm transports the tip rack and places into the wash drawer of the TipNovus Mini; drawer closes and the wash protocol begins (see table below)
3. Once the wash protocol is complete the wash drawer is opened; tip rack is removed and placed into the dry drawer where the tips are dried at 70°C for 12 minutes (simultaneously the next tip rack is moved into the wash drawer)
4. Upon completion of the drying protocol the tip rack is removed from the drawer and placed back in it’s original location in the Liconic carousel

Standard Wash - NCATS

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<th>Subprotocol</th>
<th>Reagent</th>
<th>Soak (Y/N)</th>
<th>UV (Y/N)</th>
<th>Sonication (Y/N)</th>
<th># Purges</th>
<th>Agitation (Y/N)</th>
<th>Volume (L)</th>
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