

LIMS and Lab Automation

Streamlining Sample Management: Achieving Optimal Pick List Automation

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When working within a life sciences laboratory one of the most important assets are the samples. This is why it is so imperative to preserve, always store and retrieve samples while maintaining their integrity. In the early 1990s, 2D Barcoded tubes were adopted by large pharmaceutical companies to enable them to store their drug compounds in a safe and reliable way. This allowed for the tracking of samples throughout the lab using the 2D barcode.

Let us recap the reasons for using 2D bar-coded tubes in lab automation. For many years, simple linear barcodes, often on adhesive sticky labels, have been used by scientists to identify samples. This was eminently sensible, as barcodes and bar code scanning reduce, if not eliminate, manual data entry and associated errors. An average person entering data will produce one error in three hundred keystrokes. The worst-case for errors for a 1D linear code 128 barcode are 1 in 2.8 million; however, a data matrix 2D bar code offers an error rate of close to 1 in 10.5 million. If that 2D code is laser-etched onto the tube, the risk of mis-identifying a sample is reduced to a negligible value. Therefore, the advantage of 2D over 1D is the ability to store more data in a single code and result in fewer errors deciphering codes.

In the pharmaceutical industry, it is frequent practice to suspend drug compounds in DMSO (Dimethyl Sulfoxide) stored in robust polypropylene tubes for extended periods of time. Before this, glass vials were more customary practice. This introduction, in the early 2000's, revolutionised the sample storage industry, with companies across the globe following suit and seeing the benefit of having prelabelled, secure 2D barcodes.

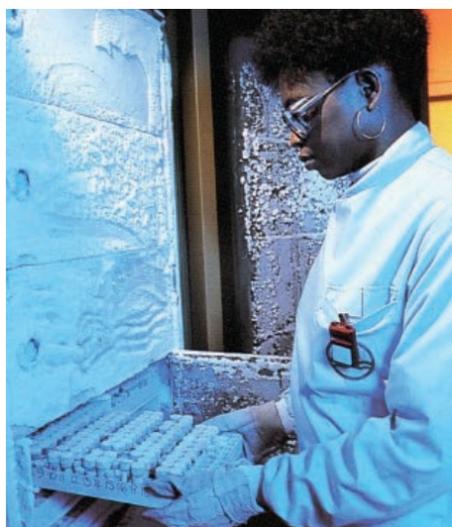


Figure 1. Cryogenic sample storage.

Today there is a wide variety of manufacturers providing both 2D-coded tubes and equipment that is compatible with this type of consumable. It thus lends itself very well to laboratory automation solutions.

For a number of years, the Mirage 2D tube rack reader, developed by Ziath and now integrated into Azenta Life Sciences, has gained prominence within its field. Its compact design, fast imaging, decoding capabilities, and compatibility with various laboratory instruments have led to its adoption in drug discovery markets worldwide. As part of their ongoing innovation, Ziath introduced the Mohawk, a semi-automated tube picker, five years ago. This article delves into the synergistic interplay of these two adaptable tools and their role in streamlining the process of pick listing for efficient sample management.

With any large store or 'library' of compounds or other samples, being able to easily retrieve a specified sub-set of samples is key to any research workflow. This is the so-called 'pick list' - a list of samples that must be in the store and retrieved for further study, replication, or transport to another location. With complex libraries, some containing millions of stored samples, it would be extremely easy to introduce errors in the handling and retrieval of stored samples, were it not for the indelible 2D barcode on the base of each tube. A pick list can be a simple numerical list in an Excel spreadsheet, a more sophisticated list produced by an Inventory Management Programme such as Ziath's Samples, Azenta's FreezerPro™ or an enterprise-level solution such as Mosaic™ from Titian Software. The result in each case is a list of sample id, tube location within a rack and often rack location within a freezer or store.

When Ziath designed the Mohawk semi-automated tube picker, their design ethos was to take a pre-existing pick list in Excel and use that to control the action of the Mohawk. This requires the use of a linear barcode reader attached to the side of the Mohawk which reads the rack barcode. If that rack contains a tube that appears in the pick list, the Mohawk will then raise the appropriate tube upon closure of the lid. The need to close the lid ensures that small, lightweight tubes remain securely in place as the solenoid-driven pins eject a tube from its rack. A micro-switch in the lid mechanism ensures that the lifting operation is quick and easy without recourse to further keystrokes. The pin stays in the raised position after lid opening allowing retrieval of the desired tube and placement in a fresh destination rack. Additionally, this rack is coded on one edge with a linear barcode. Multiple tubes in multiple racks can appear in any one pick list, although only sixteen tubes are raised simultaneously.

The advantage of using the Mohawk together with the Mirage reader is two-fold. By connecting the Mirage to the same controlling laptop or PC as the Mohawk, reader scanning can be controlled using the Mohawk software. This confers the benefit of reducing required bench space by eliminating a second PC whilst making the operation more convenient as it runs from within the same desktop application. By scanning the complete destination rack on the Mirage, the Mohawk can compare the picked tubes with those in the pre-programmed pick list. The first advantage is that any incorrect or missing tubes are identified and highlighted post-scan and this error can then be corrected. The second benefit is in the reporting. After a successful scan with all the correct tubes picked, the Mohawk software will produce a report in Excel format that shows, for each sample, the tube id, it's original location and rack code, the date and time it was picked and it's whereabouts in the destination rack, again with location and rack code. This data is used to update the inventory management program with the new location information for each sample.



Figure 2. The powerful Mohawk and Mirage combination in a biobank setting.

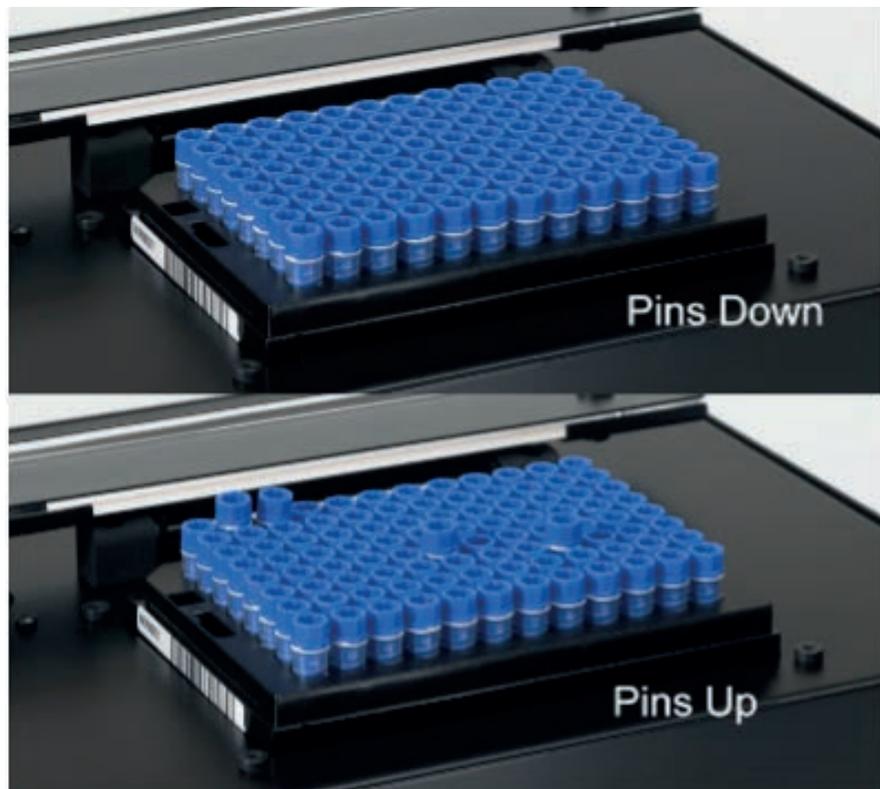


Figure 3. Automated tube picking in action.

In practice, operation of the Mohawk during tube picking can be very quick, with experienced operators reporting that they can pick tubes from multiple racks into a destination rack at a rate of about 20-25 tubes per minute. This compares very favourably with 'pick & place' robots which tend to be much slower. That allows unwanted thawing and heating of frozen samples which can be catastrophic for delicate samples.

This powerful combination of the Mohawk and Mirage is being used by scientists in busy laboratories across Europe, especially in blood banking facilities, where users all report high levels of satisfaction.

About the Author

Steve Knight has more than 30 years' experience in the design & marketing of laboratory instrumentation and robotics. He holds a BSc in Biochemistry and an MA in Marketing and has specialised in developing small to medium sized robotic-compatible instrumentation for drug discovery for the past 15 years.



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