SPOTLIGHT feature

Pumps, Valves & Liquid Handling

Choosing an Automated Liquid Handling System

Eppendorf UK

This article discusses how to achieve accurate, consistent sample preparation using the right automated liquid handling system. Despite the growing number of new technologies, instruments and automated systems now at researchers' fingertips, visit any lab and you are likely to find a skilled technician sitting amidst all the expensive apparatus, pipette in hand, carrying out routine liquid handling tasks. Still a manual process in the main, this pivotal work underpins the vast majority of the assays, analysis and investigation done in nearly every lab today.

As we know, sample prep is a multifactorial process and there are opportunities for errors to creep in at every stage. Indeed, sample collection, preparation and processing is by far the largest source of error in analytical laboratories [1]. The human factor comes into play here, with the individual carrying out an experiment being the single most likely source of data variation [2]. Inconsistent dilution techniques between samples, differences between the pipetting of multiple lab technicians, variation across the day, difference in concentration across assays can all compromise results down the line, potentially leading to poor quality data and costly re-runs.

The need for accurate, consistent sample prep is more keenly felt with the continuing trend of decreasing sample size and increasing sensitivity of analytical instrumentation. Molecular applications such as real-time PCR (qPCR), digital PCR (dPCR) and Next Generation Sequencing (NGS) all work with sample volumes in the low microliter (µL) range. Working with such tiny volumes, susceptibility to unwanted sample variability increases significantly. Any interventions that ensure assay set up is as consistent as possible will ultimately have a positive impact on data quality.

Requiring such high levels of skill and accuracy, it is little wonder that this complex, time and labour-intensive process causes a widely recognised bottleneck in lab workflows. Over the last decade, or more, a solution has been sought by turning to automation, particularly with labs under pressure to process large volumes of assays quickly, efficiently and accurately.

One of the most prevalent misconceptions about laboratory automation is that it is all about speed. Yet speed is not the be all and end all when it comes to introducing automation into the liquid handling process. Automated systems not only facilitate sample throughput with improved accuracy and minimised risk of error, but can also increase productivity by freeing up highly trained researchers from routine sample prep to focus on the skilled analysis and interpretation of the results. Moreover, transferring the strain of performing these repetitive manual tasks to an automated system will benefit your work in the lab, too. Repetitive strain injury (RSI) from use of manual pipettes and dispensers is now well documented and understood; such workplace injuries can impact lab productivity, staff turnover and even lead to costly compensation claims [3].

However, while automated sample preparation is now relatively commonplace, the introduction of such systems has not been without its share of difficulties. While it is easy to buy into claims about the latest revolutionary, fully automated, systems that profess to be the answer to a scientists' every problem, in practice many require long, intensive operator training, and users all too often find them challenging to reconfigure between different sample runs, and different applications.

So, we are left with two extremes. At one end of the scale, we have the highly skilled technician performing lengthy manual liquid handling who is fallible to human error; and at the other end, we have expensive, highly complex automated kit, that not only requires lengthy and intensive operator training, but also significant investment.

Automated liquid handling systems, to suit all budgets and workloads, are now readily available; designed to improve consistency and efficiency by eliminating both person-to-person and day-to-day variability. The best examples require hours rather than days of operator training, and are easy and intuitive to use. User-friendly computer interfaces, including pre-optimised commands and step-by-step programming guidance for the most common applications, make operation quick and easy, yet allow for customisation to adjust pipetting performance to the most demanding tasks. A small instrument footprint frees up bench space, while walk-away functionality also frees up researchers' time. Even automated systems require an element of manual input, however, and with this comes the inherent risk of human error. The latest systems include failsafe features to avoid mistakes, such as virtual 3D run simulation to allow checks of the programmed method for errors, and on deck checks to ensure correct layout, avoiding crashes as a result.

In addition to the many functional considerations when choosing an automated liquid handling system, running costs, availability of consumables, ease of use, and the level of ongoing support provided by the manufacturer should also be taken into account. It's important to ask for a demonstration of any system you are considering purchasing so that you can be confident it meets all of your needs, fully.

Making the right choice when automating your sample preparation process will pave the way for improved test accuracy and reproducibility, whilst increasing productivity levels. Reaping these benefits can have an important impact on your scientific output efficiency or businesses' ability to bring new products to market quickly, safely and efficiently.

Table 1: Global intra- and inter-plate coefficient of variation (CV) calculated for manual and automated Apo-ONE Homogeneous Caspase-3/7 assays.

Global intra- and inter-plate coefficient of variation (CV) calculated for manual and automated Apo-ONE Homogeneous Caspase-3/7 assays

		epMotion 5075t		Manual	
		Global intra-plate CV	Global inter-plate CV	Global intra-plate CV	Global inter-plate CV
HeLa cells	Plate 1	6.11 %		11.90 %	
	Plate 2	7.15 %		7.69 %	
	Plate 3	5.80 %		15.84 %	
	Plates 1-2-3		5.53 %		19.87 %
Jurkat cells	Plate 1	9.43 %		12.71 %	
	Plate 2	6.15 %		12.71 %	
	Plate 3	7.83 %		13.50 %	
	Plates 1-2-3		8.47 %		11.81 %

References

1. *Agilent Technologies Sample preparation fundamentals for chromatography. publication no 5991-3326EN.*

2. *Bustin.S.A (2002) Quantification of mRNA using real-time reverse transcription PCR (RT-PCR): trends and problems. Journal of Molecular Endocrinology. Aug 2002 vol.29 no.1.*

3. *http://www.repetitivestraininjury.org.uk/employment-and-legal.html*