Case Study

Efficiency Evaluation:
Measuring energy consumption in twisters, mixers, stirrers, & shakers

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Wet labs employ a variety of equipment types for preparing and agitating materials. Vortex mixers, magnetic stirrers, and orbital shakers are routinely. IKA have recently released the IKA Twister (*Figure 1*), a product which can perform the functions of all three of these equipment types. Products such as the IKA Twister represent a response by industry to reduce the environmental impact of scientific research. Products which use less raw materials and reduce supply chain emissions are an essential component of the scientific sector becoming carbon neutral.

Figure 1: The IKA Twister.

Equipment Performance

Working with the Learning and Research Centre at the University Bristol, several tests were carried out on the IKA Twister alongside other magnetic stirrers, orbital shakers, and vortex mixers to measure energy consumption and evaluate product efficiency. All units were monitored using the energy monitors and online monitoring platform provided by Logicall Wireless Solutions Ltd. The case study was jointly commissioned by IKA UK and Scientific Laboratory Supplies (SLS) Ltd. The first items monitored were the magnetic stirrers.

Magnetic Stirrers

Alongside the IKA Twister, two magnetic stirrers were tested. All three units stirred an 800ml flask filled with 700ml of water. Both the Hanna and SLS Lab Basics stirrers (*Figure 2*) were operated at their maximum revolutions per minute (RPM) only. The reason being that both units had a dial control which made it difficult to set precise set points below their maximum RPM. The IKA Twister can be set to operate at increments of 100 RPM up to a maximum of 3000 RPM. The IKA Twister was also tested at its maximum RPM and also the maximum set points of the other two models (*Figure 3*).

Figure 2: From left to right; Hanna HI 190M, SLS Lab Basics Stirrer, and the IKA Twister.

The IKA Twister can be set to operate at increments of 100 RPM up to a maximum of 3000 RPM, which is a larger range than the other two models. Therefore, the IKA Twister was tested at its own maximum RPM as well as at the maximum set points of the other two models (*Figure 3*).

Model	Set Point 1000 RPM	2000 RPM	3000 RPM
Hanna HI 190M	0.080 kWh/day		
SLS Lab Basics Stirrer		0.0091 kWh/day	
IKA Twister	0.072 kWh/day	0.082 kWh/day	0.096 kWh/day

Figure 3. Energy consumption of magnetic stirrers.

A feature of the IKA Twister is it can be linked with other IKA Twisters to form multiple position stirrers powered by a single power source (*Figure 4*). The energy usage of multiple position stirrers was monitored at different set points (*Figure 5*).

Figure 4: Four IKA Twisters powered by a single power source.

Set Point	Number of IKA Twisters 1	2	3	4
1000 RPM	0.072 kWh/day	0.105 kWh/day	0.180 kWh/day	0.277 kWh/day
2000 RPM	0.082 kWh/day	0.119 kWh/day	0.240 kWh/day	0.339 kWh/day
3000 RPM	0.096 kWh/day	0.142 kWh/day	0.284 kWh/day	0.427 kWh/day

Figure 5: Energy consumption of multiple IKA Twisters magnetically stirring at different set points.

Orbital Shakers

With the addition of the TVWX Shaker attachment, MS 3.3 universal attachment, and STICKMAX II sticky pad, the IKA Twister was used as an orbital shaker. The IKA Twister was tested alongside two other orbital shakers at 200 RPM, with each orbital shaker agitating a single 250ml flask containing 100ml of water. Each model also employed a STICKMAX II to hold the flask in place (*Figures 6* and *7*).

Figure 6. From left to right: the IKA Twister, SLS Lab Basics and Grant PSU-10i.

	Number of IKA Twisters			
Set Point	1	2	3	4
1000 RPM	0.072 kWh/day	0.105 kWh/day	0.180 kWh/day	0.277 kWh/day
2000 RPM	0.082 kWh/day	0.119 kWh/day	0.240 kWh/day	0.339 kWh/day
3000 RPM	0.096 kWh/day	0.142 kWh/day	0.284 kWh/day	0.427 kWh/day

Figure 7: Orbital shaker energy consumption at 200 RPM.

Vortex Mixers

Vortex mixing was carried out by the IKA Twister by adding the TVWX attachment. The energy consumption of the IKA Twister was measured alongside two other models of vortex mixers (*Figures 8* and *9*). The two other vortex mixers were operated at their maximum RPM setpoints due to the limited accuracy of the basic dial to control the RPM.

Figure 8: From left to right; the IKA Twister, SLS Vortex Mixers SLS 9602 and SLS 1620.

	Set Point		
Model	1000 RPM	2500 RPM	4500 RPM
SLS Lab Basics Mini Vortex Mixer (SLS 1620)			0.180 kWh/day
SLS Lab Basics Vortex Mixer (SLS 9602)		0.091 kWh/day	
IKA Twister	0.074 kWh/day	0.088 kWh/day	

Figure 9: Energy consumption of vortex mixing.

Discussion

The energy consumption of the IKA Twisters was comparable to other models for both the magnetic stirring and vortex mixing tests. It is also important to note that the energy consumption figures represent 24-hour usage, meaning the hourly energy consumption of these equipment types is very low at ≤ 0.005 kWh/hr.

However, when comparing orbital shaking, there was a significant difference in platform sizes, and therefore the capacity for shaking multiple flasks must also be considered within the context of efficiency (*Figure 10*). With the notable differences in platform sizes, it is likely that shaking multiple flasks using the larger orbital shakers would be the more energy efficient option compared to the IKA Twister. But once again, the baseline energy consumption would still be low.

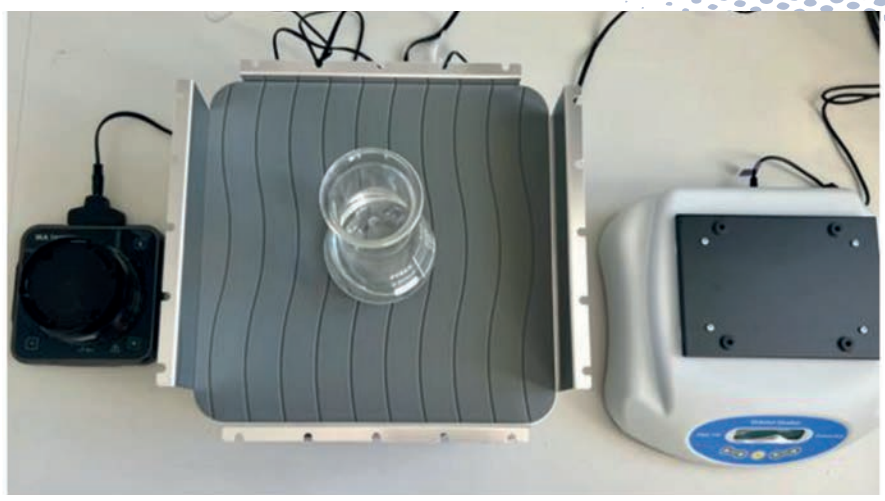

Figure 10: Varying sizes of orbital shaker platform sizes.

The space occupied by each model of equipment was also measured (*Figure 11*). With lab space being 'prime real estate', the potential space saving offered by using the multifunctional IKA Twister could be advantageous to end users and technical staff.

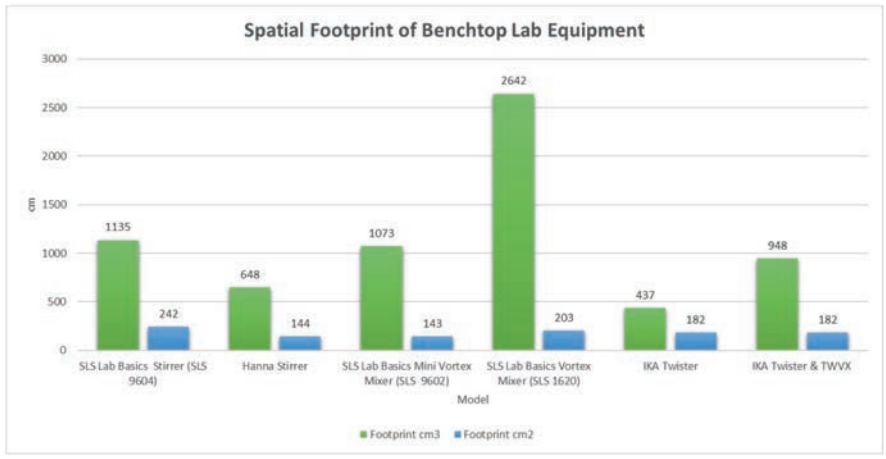

Figure 11: Space occupied by the equipment models; blue represents the space they occupy upon the lab bench, green represents to total volume occupied.

For teaching laboratories, the IKA Twister requires less space for storage, as 4-5 units can easily be stacked upon one another. Also, the ability to operate multiple IKA Twisters from a single power socket would be advantageous to laboratories with limited access to plug sockets.

The other potential advantage of using the IKA Twisters instead of the dedicated, single function equipment types could be the product's associated emissions. The IKA Twister and the TWVX attachment have a combined weight of 1.140 kg. The SLS Lab Basics 9602 Vortex Mixer weighs 0.900 kg and the SLS Lab Basics Magnetic Stirrer weighs 0.538 kg, making their combined weight 1.438 kg. Therefore, the IKA Twister uses 0.298 kg less material whilst carrying out both functions, meaning its associated emissions could be potentially less. However, another case study to conduct a full lifecycle assessment (LCA) of these units to calculate an accurate product carbon footprint and better understand the recyclability of these units would be necessary. This may be of interest to many institutions requiring accurate data to calculate and reduce their Scope 3 emissions.

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