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TRIPLE REACTION DRYSYN VS. OIL BATH

ADVANCES IN CHEMICAL HEATING AND COOLING TECHNOLOGY,
DEPARTMENT OF CHEMSITRY, UNIVERSITY OF BATH

ANDY EVANS - GREEN LIGHT LABORATORIES LTD

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INTRODUCTION

The use of oil baths is widespread throughout Chemistry research and teaching. Oil is heated within a glass container over a hotplate to temperatures of up to 230°C. Oil baths are often used with a water cooled condenser. Working with the University of Bath this existing technology has been compared to more modern alternatives which remove the requirement for using water and oil to carry out routine chemical reactions. Furthermore, recent innovations have allowed for multiple flasks to be heated on a single hotplate stirrer.

Figure 1. Oil bath (350ml silicon oil) with water cooled condenser connected to condense vapor.

THE REACTION

Working with Dr. Fabienne Pradaux-Caggiano a toluene reflux reaction was ran. On the first day of testing, a hotplate stirrer heated a 350ml silicon oil bath. The oil bath heated a single 100ml round bottomed flask filled with 50ml of toluene which was connected to a water cooled condenser. The condenser was fed by tap water which has a flow rate of 1.5 L/minute. The hotplate stirrer was set to 110C and 340rpm (figure 1). On the second day of testing the same hotplate stirrer was used with the oil bath replaced with an Asynt DrySyn MULTI-E Base fitted with three 100ml inserts (figure 2). This set up heated **three** 100ml round bottomed flasks, each filled with 50ml of toluene, each cooled by an Asynt CondenSyn 340 waterless condenser. Both reactions were energy monitored using the Koolzone

plug energy monitors and online platform. The running costs associated with running three oil baths with condensers compared to the Asynt apparatus were then compared.

Figure 2. Asynt apparatus.

RUNNING COSTS – 3 VS 1

Based on the data collected the running costs were then calculated for three different usage scenarios. These conservative scenarios highlight the savings which would be attained if using the 3 oil baths with water cooled condensers for 20, 30 or 40 days per year (figure 3). The Asynt apparatus without the hotplate stirrer was costed using list prices at £863, with the hotplate stirrer £1788. Electricity was costed at £0.13/kWh and water costed at £2.75/m3. Oil is costed based on a single change per year, oil cost was £49.20/litre.

Savings in Running Costs	Annual Usage of Exiting Units		
	3 Oil Baths With Condensers Used 20 Days/Year	3 Oil Baths With Condensers Used 30 Days/Year	3 Oil Baths With Condensers Used 40 Days/Year
kWh Saved By Asynt Apparatus/Year	38.64	57.96	77.28
Cost of Electrcity Saved/Year	£ 5.02	£ 7.53	£ 10.05
Water Saved (m3)/Year	129.6	194.4	259.2
Cost of Water Saved/Year	£ 356.40	£ 534.60	£ 712.80
Oil Saved	£ 103.32	£ 103.32	£ 103.32
Total Saving/Yr	**£ 464.74**	**£ 645.45**	**£ 826.17**
Payback for Asynt Apparatus Without Hotplate Stirrer	**1.86 Years**	**1.34 Years**	**1.06 Years**
Payback for Asynt Apparatus Including Stirrer	**3.85 Years**	**2.77 Years**	**2.16 Years**

Figure 3. Annual running cost savings attained through using the Asynt apparatus.

DISCUSSION

Using the DrySyn and CondenSyn kit in place of the traditional oil and water offered significant savings in running costs. Even with the conservative usage of using 3 oil baths 20 full days per year paybacks were under 2 years if a hotplate stirrer is not required. It must also be noted that by not using the oil baths the space required inside the fume cupboard is reduced by 2/3. With fume cupboards being significant contributors to lab running costs any reduction in required space will also help labs minimize their fume cupboard related HVAC costs. Furthermore there are other advantages of using the Asynt products:

- No oil spillages which pose a safety hazard and cost time and materials to clean up.
- No fire risk associated with water or other chemicals coming into contact with the oil bath.
- No accidental flooding.

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For further information on this study, or lab sustainability in general please contact **Andy Evans**, office@greenlightlabs.co.uk. 07833 494727