

Gas Scrubbing

Single-Chamber-Box Scrubber

Demonstration Unit

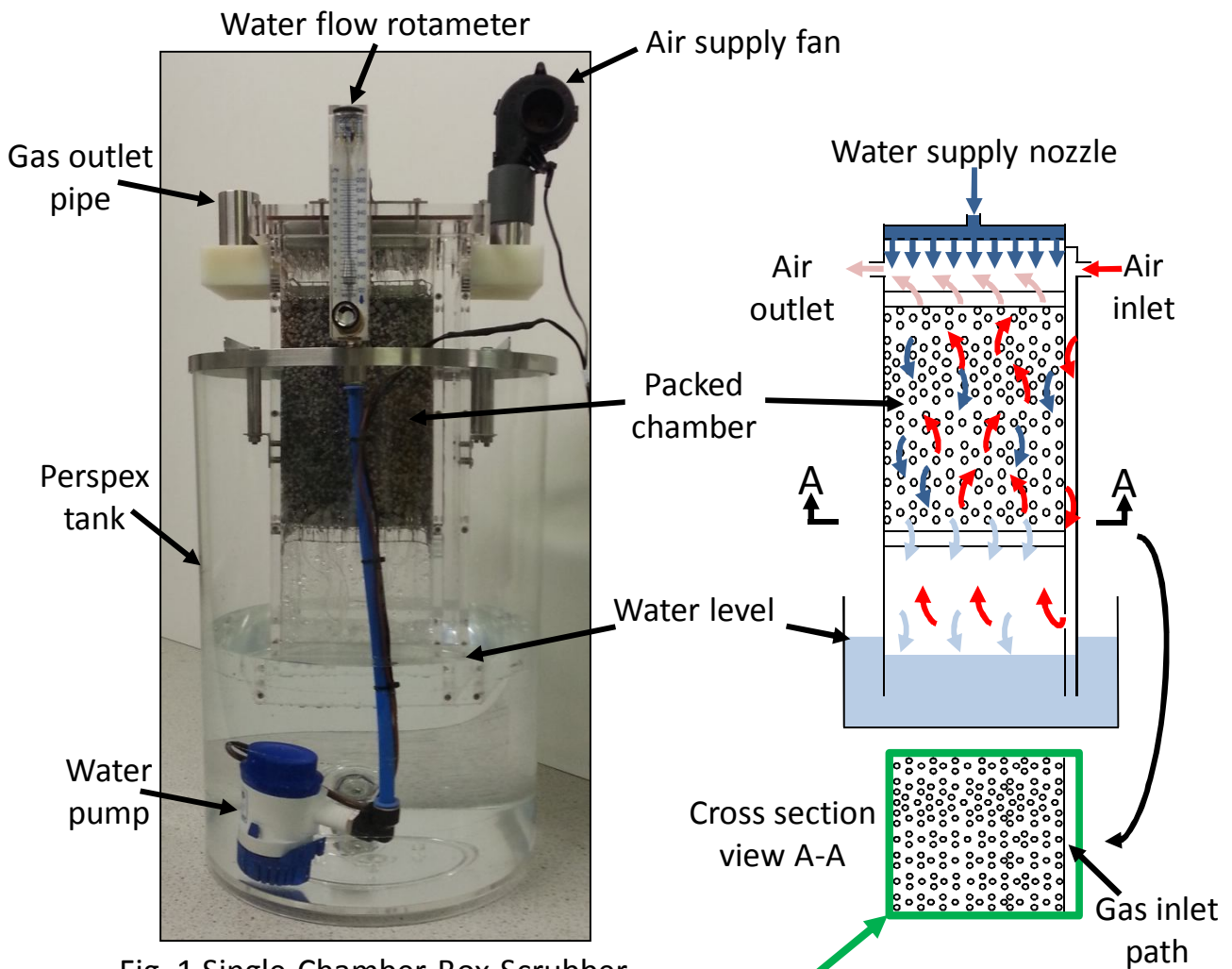


Fig. 1 Single-Chamber-Box Scrubber

Fig. 2 Represents one part of a chamber in a Multi-Chamber-Box Scrubber



Fig. 3 Multi-Chamber-Box Scrubber

Single-Chamber-Box Scrubber

The unit can be used to illustrate how:

- a chamber is packed with Dixon rings,
- the packing is supported and retained in position,
- the water is distributed across the packing and flows down to the base of the packing,
- the water seal at the base of the column is maintained, and
- the column may be flooded (to wet the packing) prior to use, which is important for increasing scrubbing efficiency.

Different forms of packing could be inserted into the chamber, and the flow of liquid over the packing observed.

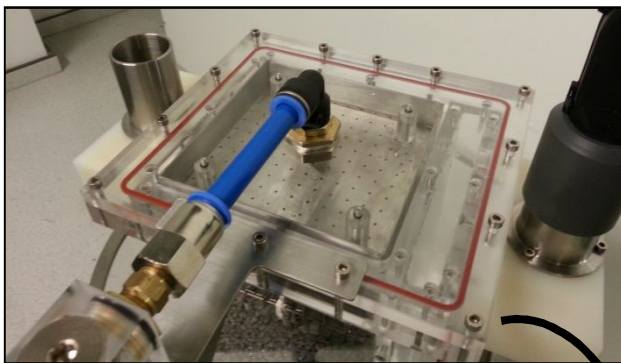


Fig. 4 The top of the chamber



Fig. 5 Air supply fan

Application 1 Re-circulating liquid flow

- The gas stream consists of air, which is drawn from the environment and is pumped through the unit by a small electrical fan (whereas in an application, the gaseous stream would contain contaminants to be removed in this process).
- The walls of the chamber are made from Perspex, which enables visual observations to be made inside the unit (whereas in an application, suitable materials would be selected to match the environment).
- In the configuration in Fig. 1, the liquid is re-circulated (whereas in the application it is most likely to flow through the unit, or have a purge stream). However, there is an option to configure the apparatus for liquid flow through the unit (see Application 2).

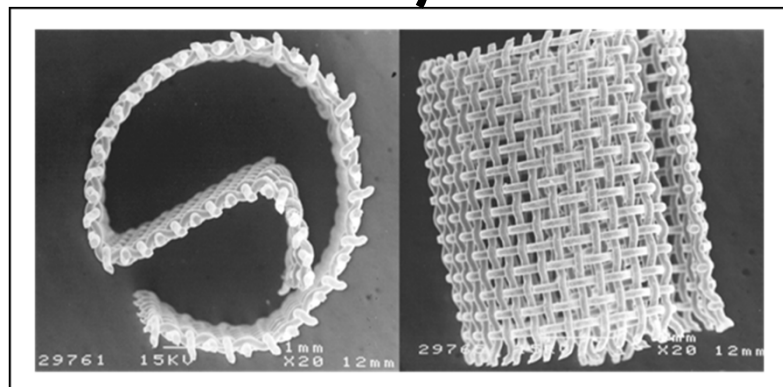
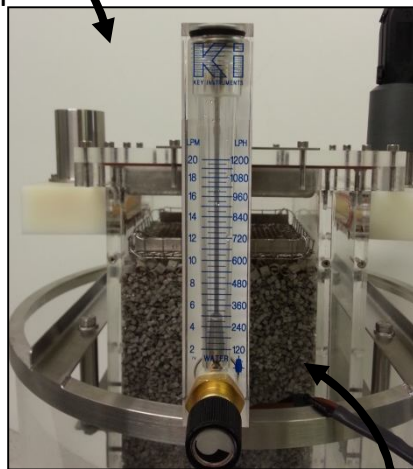


Fig. 6 Dixon rings 1/8'' (3 mm)

Application 2 Once-through liquid flow

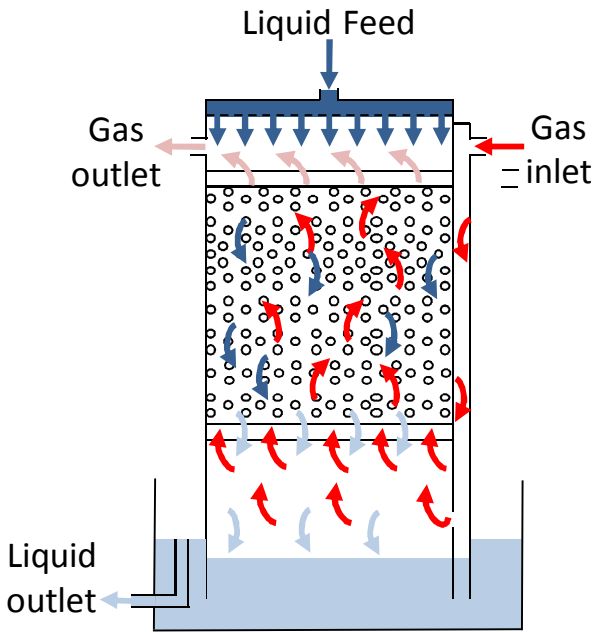


Fig. 7 Counter-current flow

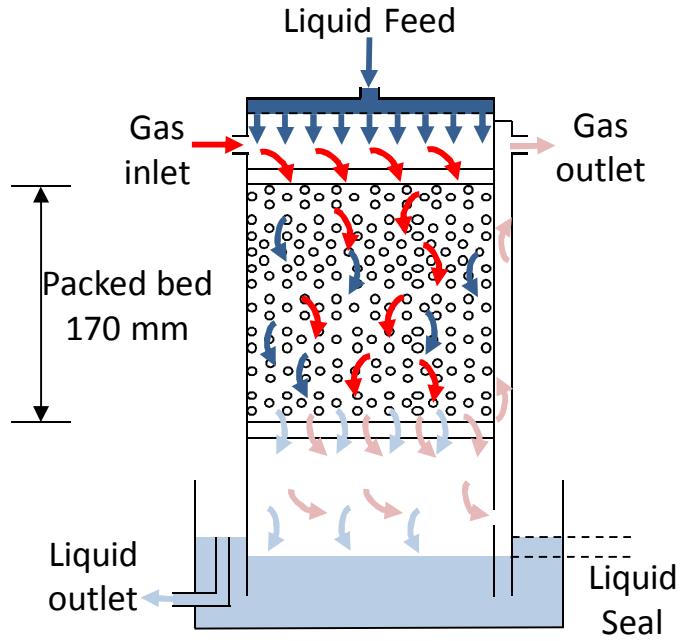


Fig. 8 Co-current flow

Quantitative Studies

Variables Adjusted	Effects Measured
Gas flow	Gas outlet composition Pressure drop Point at which column floods
Gas inlet composition	Gas outlet composition
Liquid flow	Gas outlet composition Pressure drop Point at which column floods
Liquid composition	Gas outlet composition
Liquid temperature	Gas outlet composition

Options explored	Effects Measured
Different types of packing	Changes in performance
Counter-current versus co-current flow	Changes in performance

From such scientific studies on a short bed (170 mm)

- The K_{ga} may be determined for the conditions tested
- From experiments at incrementally reduced gas inlet concentrations, the performance of a Multi-Chamber-Box Scrubber may be estimated with confidence.

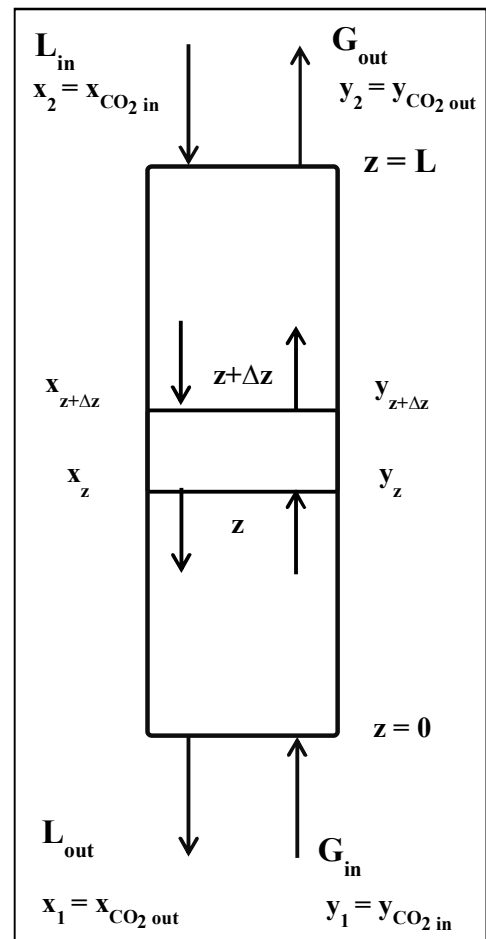


Fig. 9 Counter-current flow – development of a material balance

Table 1 Specifications of the Single-Chamber-Box Scrubber.

SCB-10D	
An external Perspex structure	1 chamber
Height	420 mm
Cross-sectional area of each chamber	133 mm x 133 mm
Number of liquid feed nozzles	1 per chamber
Spare O-ring seals	2
Spare screw fixtures to fasten top cover plate	5
Stainless steel mesh that supports the packing in the chamber	1 Set
1/8" inch Dixon Rings, which act as packing in the chamber packing depth: ~170 mm	2 litres (~1.8 litre required)
1/4" inch Dixon Rings, to be positioned at top (~15 mm layer) and at base over the mesh support (~20 mm layer)	0.5 litres (~0.4 litre required)
Approximate weight of demonstration unit (without Dixon Rings)	10 Kg
Assembly & operating instructions	
Air supply fan	1
Submerged pump	1
Reservoir sump tank	1

This type of Demonstration Unit is custom made, so the specification may vary slightly depending on the availability of sub-components used.

A quotation for the SCB-10D standard unit may be obtained from:

S&C Thermofluids Ltd, The Old Tannery, Kelston, Bath, BA1 9AN, UK

www.thermofluids.co.uk

email: tony.smith@thermofluids.co.uk

'Custom Built' Designs

Other variations may also be 'custom built' to match the particular needs for the application of interest.

Multi-Chamber-Box Scrubber

The characteristics and advantages of the Multi-Chamber-Box Scrubber are described in a separate leaflet.



Fig. 10 Side view of the 3-Chamber-Box Scrubber (without Dixon rings).

Acknowledgments

This Single-Chamber-Box demonstration unit evolved from a need to illustrate how the compact Multi-Chamber-Box Scrubber concept worked for the removal of CO₂ with seawater (from a submersible habitat), which was developed in a study funded by the Office of Naval Research (Code 322, Arlington, VA). That study involved collaboration between Dr Lew Nuckols (marshall.nuckols@duke.edu) at Duke University (US) and Prof Stan Kolaczkowski (cesstk@bath.ac.uk) at the University of Bath (UK). The Single-Chamber-Box Scrubber and the Multi-Chamber-Box Scrubbers that were used in those experimental trials were specially manufactured by S&C Themofluids Ltd.