CE SERIES

Wetted Wall Gas Absorption Column - CES

Wetted wall columns may be used to determine gas/liquid mass transfer coefficients, essential when calculating the design of absorption towers. Such coefficients form the basis of correlations used to develop packed towers.

CES examines the absorption of oxygen from air into deoxygenated water (prepared by nitrogen sparging). This is an example of liquid film controlled absorption.

The liquid film mass transfer coefficient can be determined at various mass flow rates of water.

Gas inlet and water outlet arrangement

Main console controls

Experimental content

- Calculation of liquid film mass transfer coefficients
- Variation of coefficient with mass flow rate
- Variation of oxygen flow rate to determine power law relationship
- To determine the power-law relationship between the liquid film mass transfer coefficient

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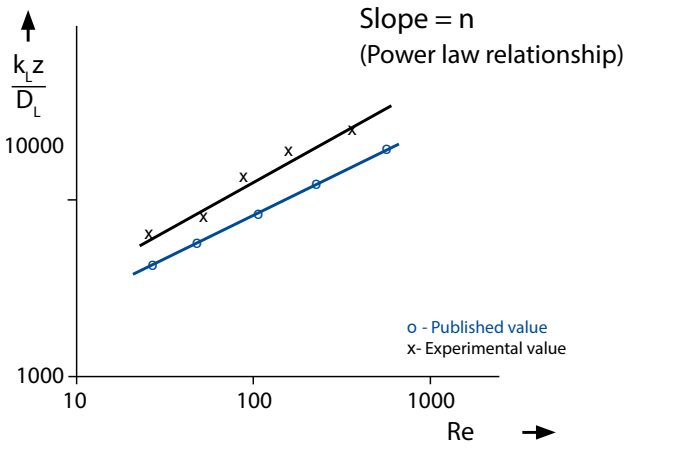
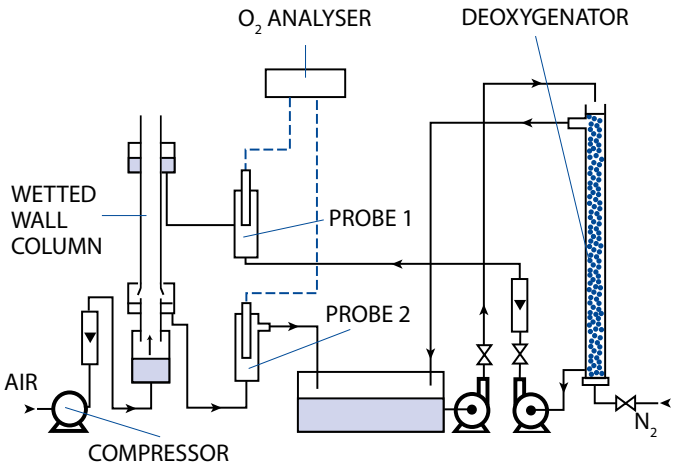
Applications
ChE ME CE IP



Logarithmic graph to determine the power law relationship



Schematic diagram of the unit

Typical experiments

The system chosen for the experiment is the absorption of oxygen into oxygen-free water. In this system the solubility and enthalpy of solution are small and by saturating the inlet air with water, humidification effects are eliminated. Thus it is possible to maintain reasonably isothermal conditions throughout the column.

Experimental procedure allows a power law relationship to be calculated and comparison is made between this and published relationships such as:

$$(Sh) = f(Sc)^{1/2}(Ga)^{1/6}(Re)^{n}$$

That is, for a given gas/liquid system:

$$(Sh)_L \quad \alpha \quad (Re)_L^n$$

or

$$\frac{k_L z}{D_L} \alpha \left(\frac{4\Gamma^n}{\mu_L}\right)$$

Thus, construction of a logarithmic graph:

$$\frac{k_L z}{D_L} \quad \text{vs } (Re)_L$$

for various flow rates of oxygen (in the form of air) a power law can be determined and compared to published values.

In order to plot the graph, the student must calculate log mean concentration difference, mass flux and transfer coefficients. Also, a full error analysis can be carried out.

Description

The system components are mounted within a floor standing painted steel framework.

The wetted wall column is a glass column with water inlet and outlet sections and is gimbal mounted to ensure that it can be set accurately in a vertical orientation.

The deoxygenating column is of similar overall size to the wetted wall column, standing vertically adjacent to it. Beside the column is a control console housing flow meters, pump controls and oxygen analyser. Situated between the columns are two special housings containing the oxygen analysis probes which monitor the oxygen content in the water entering and leaving the absorption column. The apparatus uses water as the working medium, contained in a storage tank at the rear of the unit. Pumps delivering water to the deoxygenator and the absorption column are located at the base of the unit.

In operation, water is sparged with nitrogen in the deoxygenator before entering the top of the wetted wall column. Air is pumped by the integral diaphragm-type air pump into the base of the column. The air passes up the column, giving up the oxygen to the water. Dissolved oxygen at inlet and outlet can be measured in rapid succession. The water drains into the storage tank to be recycled to the deoxygenator.

Requirements

Scale

Electricity Requirements:

CES-A: 220-240V / 1ph / 50Hz
CES-G: 220-240V / 1ph / 60Hz

Consumables:

Nitrogen supply @ 1 bar 50Ltr with pressure regulator

Ordering specification

- A floor-standing apparatus, used for demonstration and determination of liquid film mass transfer coefficients
- Comprises both wetted wall column and a deoxygenating column, a water tank, two water pumps, an air pump and an oxygen meter with two probes
- The wetted wall section is 900mm long, 32mm internal diameter and made of glass
- The deoxygenating column is 1570mm long, 26mm internal diameter and made of clear acrylic
- The equipment is used to study absorption of oxygen from air into deoxygenated water, specific demonstrations include:
  - Calculation of liquid film mass transfer coefficient
  - Variation of this coefficient with mass flow rate
  - Determination of the power law relationship

Overall dimensions

Length	2.50m
Width	1.00m
Height	0.50m
Packed and crated shipping specifications	
Volume	2.1m^3
Gross weight	252Kg

Technical specifications

Wetted wall column	
Height	900mm
Internal diameter	32mm
Material	Glass
Deoxygenating column	
Height	1570mm
Internal diameter	26mm
Material	Clear acrylic
Range	600-5000 ml/min
Water flow meter	
Range	20-280 ml/min
Deoxygenator	
Feed pump	20 l/min @ 2m head
Absorption column feed pump	10 l/min @ 1m head
Air feed pump	24 l/min @ 1 kg/cm^2
Sump tank capacity	Approx 40l
OXYGEN METER	
Saturation	
Range	0-199.9%
Accuracy	± 0.5%
Resolution	0.1%
Temperature compensation	0-50°C automatic
Concentration	
Range	0-19.9ppm
Accuracy	± 0.2ppm
Resolution	0.1ppm
Temperature compensation	0-50°C automatic
Temperature	
Range	-100°C to +200°C
Accuracy	±0.3°C
Resolution	0.1°C

Ancillary equipment

Cylinder of compressed nitrogen gas with pressure regulator (not supplied).

Ordering codes

CES-A: 220-240V / 1ph / 50Hz
CES-G: 220-240V / 1ph / 60Hz