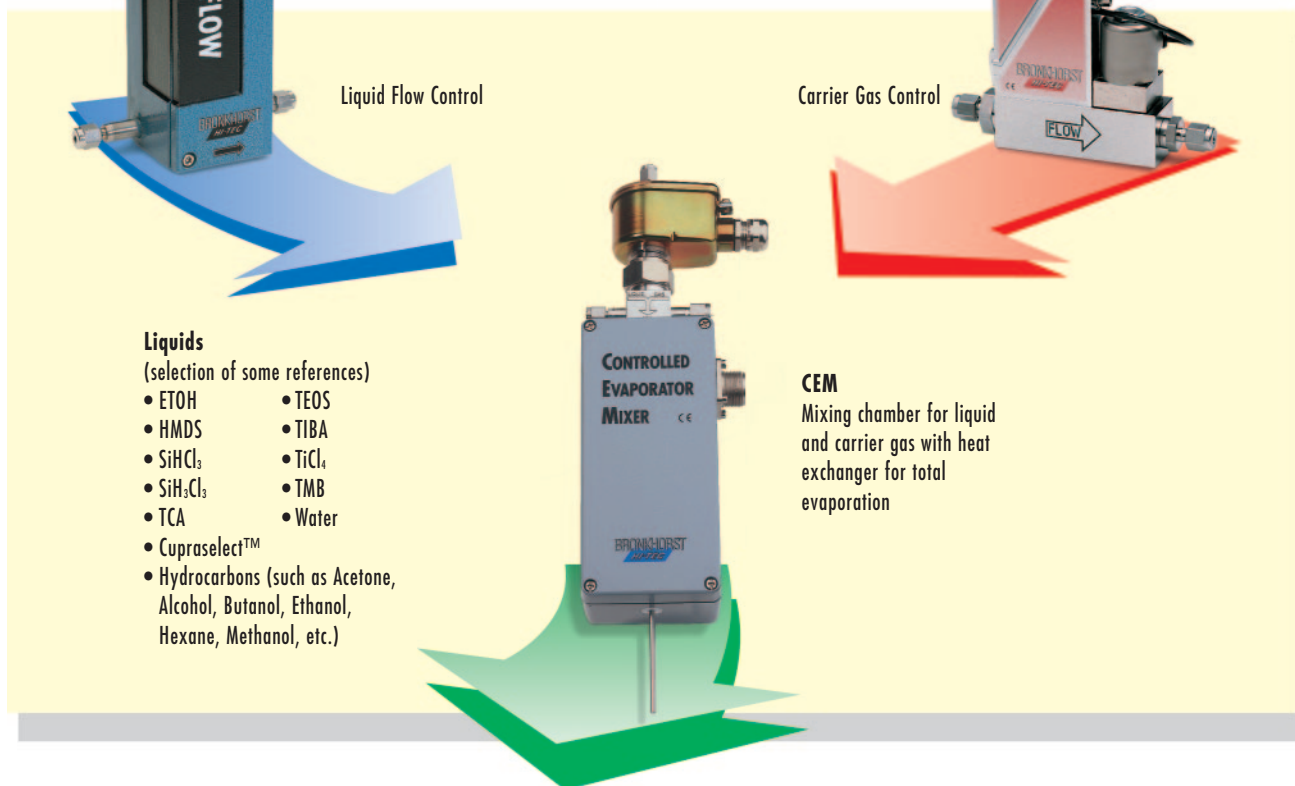


"CEM" LIQUID DELIVERY SYSTEM WITH VAPOUR CONTROL



INTRODUCTION

In a number of processes 2 or more components must be mixed together. In instances where it comprises a vapour of a liquid in a carrier gas, traditional "Bubbler Systems" and the more recent "Vapour Source Controllers" have been used. These devices, however, can often not handle sufficient quantities of liquid with a low vapour pressure, or perform in an imperfect way. Moreover, they cannot instantaneously provide vapour of a mixture of liquids with different vapour pressures.

Bronkhorst High-Tech B.V. have therefore developed a unique patented system to realise Mass Flow Control of Vapours with an innovation: the "CEM"-Liquid Delivery System (LDS). It can be applied for atmospheric, pressurized and vacuum processes.

DESCRIPTION

At room temperature the liquid, for instance TEOS, HMDS, Cupraselect or water, is drawn from a container with an inert gas blanket, or membrane, and measured by a liquid mass flow meter type μ -FLOW or LIQUI-FLOW®. The required flow rate is controlled to the setpoint value by a control valve (C) forming an integral part of the patented liquid flow and carrier gas mixing valve (M). The then formed mixture is subsequently led into the evaporator to achieve total evaporation (E). This explains the abbreviation of "CEM" viz.: Control - Evaporation - Mixing, the 3 basic functions of the Liquid Delivery System.

FEATURES

- accurately controlled gas/liquid mixture
- fast response
- high reproduceability
- very stable vapour flow
- flexible selection of gas/liquid ratio
- lower working temperature than conventional systems



SPECIFICATIONS

The set-up of a "CEM"-system usually consists of:



1) COMBI-FLOW Mass Flow Controller for Gases

For measurement and control of the carrier gas flow. The amount of carrier gas required for the evaporation depends on the application (flow range, liquid, pressure, temperature). We advise at least 50 ml_n/min for the transportation of the liquid source from the mixing valve into the heat-exchanger. To avoid a large pressure drop across the system, the gas flow should be restricted to approx. 100 l_n/min for the 1000 W unit and approx. 10 l_n/min and 1 l_n/min respectively for the smaller units. For more information about Bronkhorst High-Tech MFCs see brochures COMBI-FLOW and EL-FLOW®.



2) LIQUI-FLOW® Mass Flow Meter for Liquids

For measurement of the liquid source flow. Bronkhorst High-Tech offers liquid flow meters for 1,5...30 mg/h up to 0,4...20 kg/h of water equivalent. For more information see brochure LIQUI-FLOW® and leaflet μ-FLOW.

3) "CEM" 3-way Mixing Valve and Evaporator

For control of the liquid source flow and mixing the liquid with the carrier gas flow resulting in total evaporation; complete with Temperature Controlled Heat-Exchanger to add heat to the mixture to realise complete vapourization. (T_{max} 200°C).

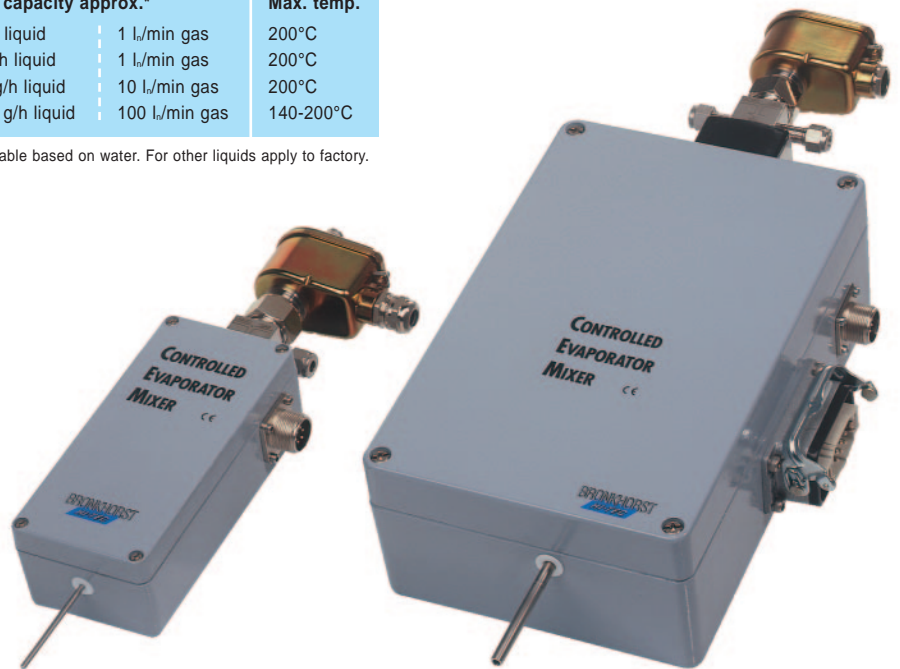
Model	Description	Max. capacity approx.*		Max. temp.
W-101-9N0-P	10 W, for μ-FLOW	2 g/h liquid	1 l _n /min gas	200°C
W-102-NN0-P	10 W, for LIQUI-FLOW®	10 g/h liquid	1 l _n /min gas	200°C
W-202-NN0-P	100 W, for LIQUI-FLOW®	100 g/h liquid	10 l _n /min gas	200°C
W-303-NN0-P	1000 W, for LIQUI-FLOW®	1000 g/h liquid	100 l _n /min gas	140-200°C

*Depends on liquid; table based on water. For other liquids apply to factory.

Connections:

- inlet liquid
- inlet gas
- outlet mixture

0	None
1	1/8" OD compression type
2	1/4" OD compression type
3	6 mm OD compression type
7	1/4" Face Seal female
8	1/4" Face Seal male
9	Other



Optional

- Separate control valves for mixing 2 fluids.
- Separate heat exchanger / evaporator.

4) Power Supply/Readout System

For the control of the gas flow, liquid flow and temperature of the heat-exchanger.

Typical example:

E-7110- or E-7310- 10-12-33 (or -34)

1/2 19" rack or table top housing for 2 channels + temperature control 10 W (or 100 W).

5) Interconnecting Cables

1 x cable MFC - electronics 1 x cable Mixing Valve - Electronics with split-adaptor.

1 x cable LFM - electronics 1 x cable Heat-Exchanger - Electronics.

6) Power Unit (for 1000 Watt Evaporator only)

In a housing for field mounting or panel mounting. With 2 x cable for connection to PS/Readout System.



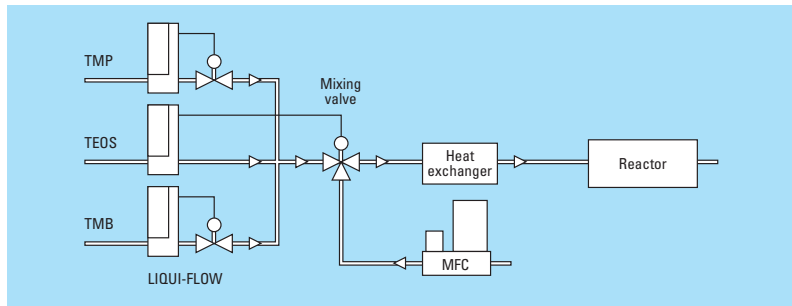
APPLICATIONS

Introduction

In combination with LIQUI-FLOW® liquid Mass Flow Meters/Controllers and MFCs a number of interesting and difficult to solve applications can now be handled by installing a "CEM"- system.

The "CEM"-system has been successfully applied in a large number of different applications, such as dielectrics, ferroelectrics, metals and superconducting materials in

Monomer control in planarization processes with subsequent evaporation

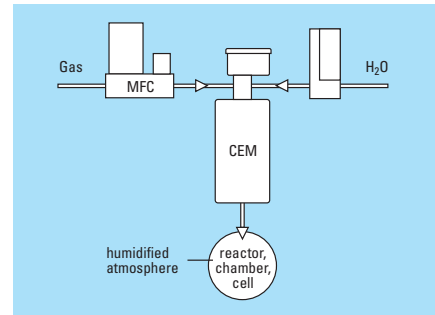


CVD (Chemical Vapour Deposition)

Process	Technique	Fluid
Planarization	BPSG	TEOS, Tomcats, TMP, TMB
Steam Oxidation	Thermal Decomposition	H ₂ O
Metal Deposition	MOCVD	Liquid Precursors: Ti, Al, Pb
Metal Compound	MOCVD	Liquid Precursors: CupraSelect™
Deposition Etching	Thermal Decompositions	Trichloroethane, Trans LC
High-Temperature Super Conductors	CVD	H ₂ O
Hardening	Thermal Decomposition	TiCl ₄ , SiCl ₄ , VaCl ₄
Thin Film Silicon Layers (optical)	CVD	HMDS, TEOS etc.
Surface Treatment	CVD	TiCl ₄ , TDEAT

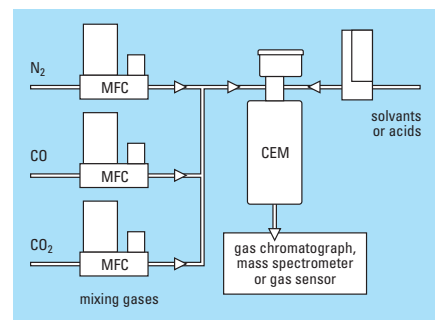
Defined Humidification of Gases

The "CEM"-system is ideally suited to the accurate adjustment of dew or moisture. The intrinsic characteristics of large dynamic range and high accuracy ensure that the moisture level can be controlled with great flexibility from only a few ppm up to virtually 100%, whilst also maintaining a very high stability in dew-point. Full functionality is retained with operating pressures as high as 64 bar.



Calibration of Gas Chromatographs, Mass Spectrometers and Gas Sensors

Through the combination of LIQUI-FLOW®-Mass Flow Controllers and the "CEM" System, gas phase concentrations can be produced as desired. Thus Mass Spectrometers or Gas Chromatographs can be calibrated as the reference stream from the CEM is both highly reproducible and highly accurate due to the direct action of the Mass Flow Controllers.



Miscellaneous

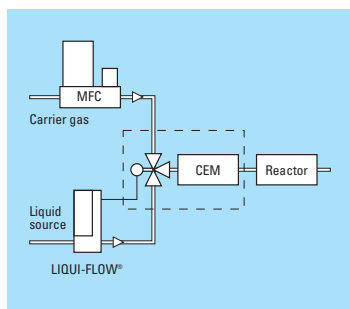
- Analysers with reference gas vapour concentrations;
- Toxic gas effects on protective clothing;
- Analysers with reference H₂O vapour concentrations;
- Anaesthetics etc.;
- Humidification of fuels;
- Crystal breeding installation.

Advantages by exchanging Bubbler Systems against "CEM"

In many cases small concentrations of vapours are made by bubbling a carrier gas through the liquid. This method requires optimum pressure and temperature control of the bubbler system, which is expensive. Moreover, the response time is very slow, the absolute accuracy is low and the bubbler system has a poor long term stability.

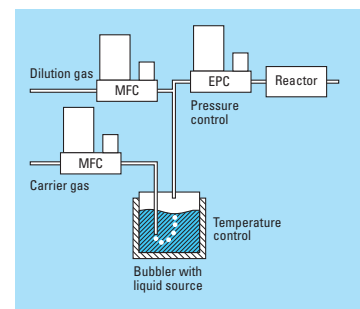
Bronkhorst High-Tech B.V. propose a much more direct approach, viz., control the required quantity of liquid to reach the desired concentration, under room temperature, with a LIQUI-FLOW® or µ-FLOW liquid Mass Flow Meter; this instrument forms part of a "CEM"-system in which the defined quantity of liquid is mixed with the carrier gas and vapourised. The method is straightforward, and virtually any concentration can be made in a matter of seconds with high accuracy and repeatability.

"CEM"-system, Controlled Evaporation Mixing



A liquid/gas mass flow controlled mixing system with subsequent evaporation into atmospheric, pressurized or vacuum processes.

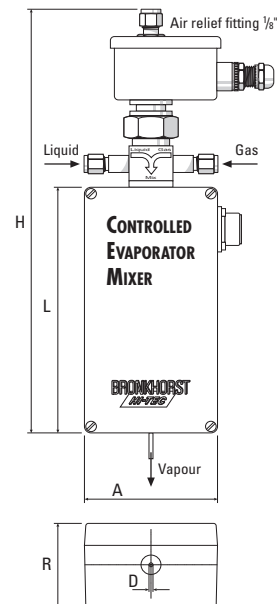
Classical Bubbler System



Dimensions "CEM" 3-way Mixing Valve and Evaporator

Model	Dimensions in (mm):					Weight (kg)
	A	D	H	L	R	
W-102 / W-202	80	1/8"	295	175	60	2,1
W-303	180	1/4"	443	280	103	9,5

All dimensions are subject to change without notice.
Certified drawings are available on request.



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