

Water Treatment Division

Ozone Contacting



INDUSTRY BULLETIN 430

In order to obtain a high mass transfer rate between a liquid and a gas, the interfacial area between the gas and the liquid must be made as large as possible, and the interfacial thickness made as small as possible. This is a natural consequence of Fick's Law of Diffusion which states that:

$$dm/dA = KAc/ds$$

where dm/dA = the rate of diffusion across an area "A"

K = the diffusion coefficient

dc/ds = the concentration gradient

The key to success in many inline static mixer applications is to carefully control the entrance conditions. In other words, we control the manner in which the two components or phases are first introduced to each other before they enter the static mixer.

A spherical bubble is a perfect example of a configuration where the surface area has been minimized relative to the volume contained. However, if we take a given volume of gas that would normally be contained in a single bubble, and divide that volume among many bubbles, we start to improve the situation.

Example: Suppose we have a mass of gas that occupies a spherical volume of one liter at a given temperature and pressure. Such a mass of gas would have a surface area of 483 square centimeters and a diameter of 12.4 cm.

Not let us suppose that we divide this gas into 100 bubbles of equal size where the total volume of gas remains the same. Our surface area has now increased to 2290 cm² while each bubble diameter has been reduced to 2.7cm. Our surface area to bubble diameter ratio has gone from 483/12.4 or 39, to 2290/2.7 or 848, an improvement of about 22 times. This is the factor I_{MD} by which we have improved molecular diffusion.

$$I_{MD} = (\text{Total bubble A/D ratio}/\text{Single bubble A/D ratio})$$

Let us now construct a table showing how we win in mass transfer as we reduce the initial bubble size of one liter.

No. of bubbles	1	100	1.9×10^7
Diameter cm	12.4	2.7	20 μ
Area cm ²	483	2290	1.5×10^9
_{MD} Factor	---	22	1.9×10^{10}

This table makes it obvious how important entrance conditions can be when contacting a liquid and a gas.

The Komax line of ozone contacting mixers has been carefully designed to function in four controlled sequences.

- 1) Ozone gas is introduced to the main water flow via a specially designed injector. This consists of hydrofoil structure made from stainless steel microspheres. It is integrated with a mixing element to produce a stream of microscopic bubbles approximately ten to 20 microns in diameter.
- 2) Next, a first set of Komax mixing elements instantly distributes these tiny bubbles across the full diameter of the main water flow by does so without introducing any wet output spin from the mixing elements which could cause centrifugal segregation of the water/gas flow.
- 3) Now follows a drift space that allows for interaction time between the gas and liquid.
- 4) Finally, another set of Komax mixing elements break up bubbles that could have been coalesced into larger ones, allowing the downstream pipe to complete interaction between the gas and water flow.

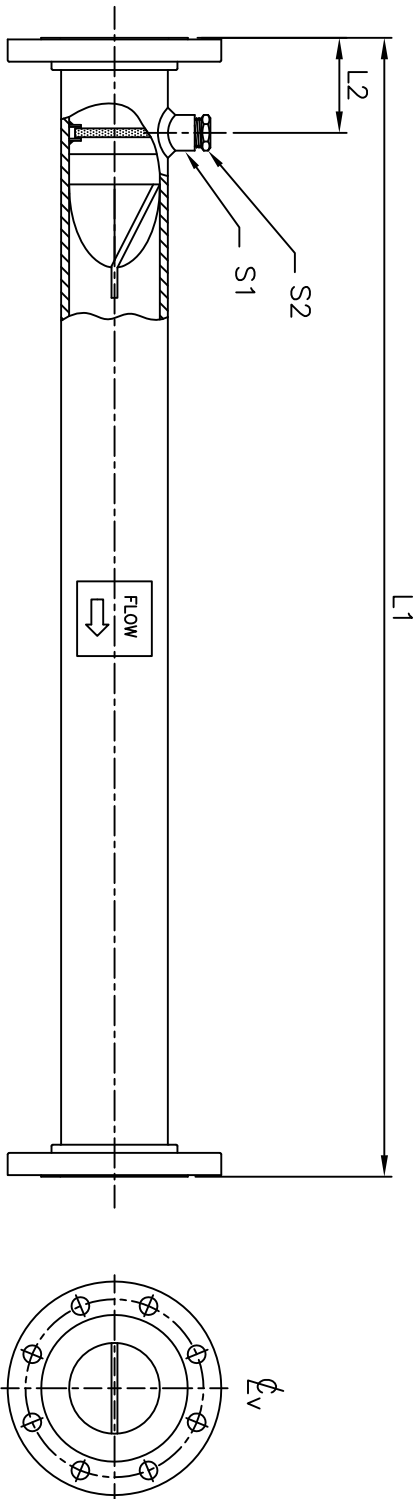
The "Design Flow" listed on the chart of the next page has been selected to produce a velocity of 6 ft/second. This allows effective operation down to 50% of the design flow listed. At the design flow value, all mixers will have a pressure drop of 3.5 psi and typically 94% to 98% mass transfer.

To calculate pressure drop at the other flow rates, the following equation may be used.

$$\Delta P = 0.016Q^2/d^4 \text{ psi}$$

where Q = flow rate in the US gpm

d = line size in inches



HOUSING: SCHEDULE 40 (S.S.) OR SCHEDULE 80 PVC

END CONNECTIONS:

F – FLANGED: 150LB (ANSI B16.5)

T – NPT THREAD, AVAILABLE SIZE 1" – 4" ONLY

MIXING ELEMENTS: 4 (FOUR)

INJECTOR: 20 MICRON POROUS

T316 STAINLESS STEEL (REMOVABLE)

TABULATION BLOCK

PIPE SIZE NPS	S1 NPT SIDE COUPLING	S2 NPT GAS INPUT CONN.	L1 in.	L2 in.	DESIGN FLOW, gpm ($\Delta P = 3.5$ psi) ALLOWS 50% TURNDOWN
1	1/4	1/8	13	3 1/2	15
1 1/2	1/4	1/8	18	4 1/4"	33
2	1/2	3/8	24	4 1/4	60
2 1/2	1/2	3/8	30	6 1/4	92
3	1/2	3/8	36	3	130
4	3/4	1/2	48	4	235
6	3/4	1/2	72	6	530
8	3/4	1/2	96	7	940
10	1	3/4	120	8	1470

ALL DIMENSIONS ARE IN INCHES

DOWNSTREAM END VIEW

KOMAX® SYSTEMS, INC.
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OUTLINE & MOUNTING CONFIGURATION
 STANDARD KOMAX OZONE MIXER
 AVAILABLE IN S.S., PVC, FRP & OTHER MATERIAL

SCALE: 60 = 1" APPROVED: DRAWN BY: EA

DATE: 12-10-07 REV. DATE:

CUSTOMER: QUOTE NO.: CODE# 004-29 DRAWING NUMBER: PROPOSA