Storm Mixer
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Using a Static Mixer as a Flash Mixer

With high levels of mixing and turbulence, a static mixer is a natural choice for flash mixing.

The nature of a static mixer in a pipeline (unlike a mechanical mixer in a basin or tank) or a pipe flocculator is that the mixing is short in nature (1-5 seconds) and more aggressive.

Flocculation will occur downstream of the mixer. The small "pin flocs" will be rapidly mixed when they are small and cannot be damaged and will grow in size as the liquid progresses further down the pipeline or into a tank or basin.

Design criteria for the flash (static) mixer must be carefully selected. Although the velocity gradient (G-value) is often used as a design guide, it has been traditionally used on mechanical mixing, and does not translate well to other types of flash mixing such as static mixers or pipe flocculators.

Static mixers in general can handle pipe flow variations of about 1:10 ratio however this range is too wide for good flocculation (minimum/maximum flow).

Plant flow variation for optimum flocculation static mixing should be less than a 1:5 ratio.

Expect that the desired G x t for a static mixer to be in the 350-1700 range (1000 average) and that *t* = 1 to 5 sec (ref 1)

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Designing a Flash Static Mixer

For purposes of sizing of the mixer, you can refer to the Storm Mixer data sheets for lengths and pressure drop information.

For Flocculation, typically a low pressure drop static mixer (a mixer that has 1/3 to 1/2 of the standard mixing element pressure drop) is used to reach this target G x t value. As a rough rule of thumb you could use the standard mixer length and reduce the pressure drop accordingly

Storm Mixer technical personnel are available to discuss your application.

Example of the G-value Calculations

Flow parameters:

Maximum Plant Flow Rate (Q, Q_1)	Maximum flow rate is 10 MGD (15.5 ft^3/s) (1577 m^3/hr) (6,940 gpm) Minimum flow rate is 3.6 MGD (5.6 ft^3/s) (568 m^3/hr)(2,498 gpm)
G x *t*	For In-line static mixers G x t = 350-1700 (1000 average) and t = 1-5 s Ref 1
Pipe Diameter (*d*)	20 in (500 mm) (1.67 ft)
Head Loss (*h*)	At 10 MGD *h* = 2 ft (1.3 psi) (9 kPa) At 3.6 MGD *h* = 0.25ft (0.15 psi) (1 kPa)
Effective length of mixer	60” (5 ft)

Calculation of Velocity (*v*) of Liquid in Pipe

$$v = \frac{0.408 \times Q_1}{d^2}$$

Where Q_1 = Flow rate (usgpm)
And *d* = diameter of pipe (in)

$v = (0.408 \times 6940) / (20)^2 = 7.1$ ft/sec

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Calculated Values

Velocity of liquid in pipeline (Maximum)	7.1 ft/sec
Velocity of liquid in pipeline (Minimum)	2.6 ft/sec
Volume of Mixing zone (*V*)	10.8 ft^3
Time in mixing zone (*t*) (Length of mixer/velocity of fluid)	0.7 sec at maximum flow 1.9 sec at low flow

Calculating Energy Input

$G = (\frac{P}{\mu V})^{0.5}$ and $P = Qwh$

G = root-mean-square velocity gradient, or rate of change of velocity, s^{-1}
P = power input, lb-lb/s
μ = dynamic (absolute) viscosity, *lb- s/ft²* [2.7×10^{-5} lb- s/ft^2 @ 50 ºF]
Q = flow rate (ft^3/s)
w = unit weight of water (62.4 lb/ft^3)
h = pressure drop (ft)
V = Volume of the mixing zone (ft^3)

P = Q*wh* = 15.5 x 62.4 x 2 = 1934 ft-lb/s

$G = (\frac{P}{\mu V})^{0.5}$ G = $(1934 / (2.7 \times 10^{-5} \times 10.8)^{0.5}$ = 2575 s^{-1}

Summary

Flow Rate (MGD)	Head Loss (ft)	G (s^{-1})	*t* (s)	G x *t*
3.6	0.25	546	1.9	1037
10	2.0	2,575	0.7	1,802

References:

1. *Integrated Design of Water Treatment Facilities, Susumu Kawamura, Wiley Interscience 1991*