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Summary of “Performance of Induction Mixers for Disinfection of Wet Weather Flows”

This is a summary of the reports published by EPA/ETV in July 2002. Environmental Technology Verification (ETV) carried out the comprehensive performance testing of Waterchamp (WC) and Gas Mastrrr (GM) and published two separate reports, one for WC and the other for GM. This research program was a part of Wet Weather Flow (WWF) Technologies Program operated by NSF International in cooperation with the EPA.

Verification Testing Description:

Testing was performed at the S.O. Conte Anadromous Fish Research Center, Turners Falls, MA, U.S.A. The laboratory consists of three large indoor flumes (10' W x 10' D x 104' L) with a total capacity of 150 ft³/s. Each induction mixer was installed in the test flume, and tested separately under nominal flow velocities of 0.5 ft/s, 1.25 ft/s, and 3.0 ft/s. A sampling rig was positioned at locations 5 ft, 10 ft, and 15 ft downstream of the mixer. The size and nature of the chemical plume was characterized by measuring the dye concentration over the entire cross-section of the flume.

Parameters in Analysis:

Mix Factor: The mix factor indicates the percentage of the total cross-sectional flume area that experienced a theoretical complete mix. A mix factor of 1.0 indicates a complete theoretical mixing. As shown in the Table 1, mix factors of WC are repeatedly 20% to 70% higher than GM depending on the flume velocity and sample locations. The test results suggest the WC achieves superior mixing than GM.

Max. Normalized Concentration:

Maximum normalized concentration is the highest concentration of tracer dye observed within the plume and is an indicator of the uniformity of the mixing intensity produced by the mixer. The smaller the ratio, the more uniform distribution of the mixing intensity. The experimental data clearly proves that WC generates much more uniform distribution of mixing intensity. Uniform mixing intensity will lead to more homogeneous reaction of chemicals in the system, minimizing any possible local under-dosing or over-dosing.

Standard Deviation of the Normalized Concentration:

This parameter is another indicator of uniformity of mixing energy in the system. More uniform mixing is represented by smaller standard deviations. A standard deviation of 0.0 represents complete uniformity of mixing. Again, USFilter WC consistently develops much smaller standard deviations than GM for all sampling locations.

Mixer Sizing Criteria (HP-to-MGD Ratio):

This is an interesting parameter that can be a measure of what size (horse power) of induction motor is required to achieve sufficient mixing. The report used 700/sec as the minimum G-value for disinfection processes. The HP-to-MGD Ratio of WC ranges between 0.22 and 0.31 HP/MGD, which means it requires 0.22 to 0.31 HP to effectively treat 1 MGD of flow. Respective ratio of GM ranges from 0.46 to 0.53 HP/MGD. The test results suggest the GM customer must use twice the HP unit to achieve the same mixing performance as the WC. Therefore, a larger HP unit increases overall power consumption and associated energy costs.

Specifiable Parameters:

If the specification includes Mix Factor and Mixer Sizing Criteria (or HP-to-MGD Ratio), WC consistently outperforms GM with proven/published data. For example, “The induction mixer (5-, 10-, 20-HP) shall have the HP-to-MGD Ratio of 0.35 or less for the flow rate of up to 3 ft/s;” “5-HP induction motor shall have a minimum Mix Factor of 0.60 at the flow rate of 0.5 ft/s and 10 ft downstream of the mixer.”



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The two reports contain a considerable amount of data with detailed explanation in over 140 pages, but did not attempt to make direct comparison between the two induction mixers. See website <http://www.epa.gov/etv/verifications/vcenter9-2.html> for complete reports. However, it is evident that WC consistently outperforms GM when comparing critical performance characteristics. The testing was carried out at the same facility, under the same conditions. The final test results are factual and non-biased.

Summary of 5-HP, 10-HP, and 20-HP Mixer Performance

Mixer HP	Flow Rate ft/sec	Sample Location ft	Mix Factor		Max Norm. Conc.		Standard Deviation		HP-to-MGD Ratio	
			WC	GM	WC	GM	WC	GM	WC	GM
5	0.5	5	0.65	0.47	1.64	2.13	0.33	0.69	0.31	0.50
		10	0.68	0.48	1.32	1.68	0.17	0.47		
		15	0.68	0.54	1.16	1.47	0.10	0.33		
	1.25	5	0.43	0.32	3.33	6.55	1.04	1.84		
		10	0.49	0.35	2.55	4.47	0.74	1.51		
		15	0.46	0.39	2.07	3.66	0.54	1.22		
	3.0	5	0.28	0.17	10.75	13.34	2.31	2.61		
		10	0.35	0.28	7.14	8.52	1.80	2.08		
		15	0.36	0.32	5.11	6.66	1.48	2.00		
10	0.5	5	0.77	0.57	1.21	1.49	0.09	0.30	0.26	0.46
		10	0.80	0.56	1.10	1.28	0.05	0.17		
		15	0.76	0.43	1.07	1.16	0.04	0.11		
	1.25	5	0.62	0.44	1.78	3.02	0.42	1.04		
		10	0.69	0.43	1.42	2.39	0.24	0.74		
		15	0.69	0.46	1.24	2.13	0.16	0.61		
	3.0	5	0.37	0.23	5.88	12.00	1.64	2.41		
		10	0.38	0.33	4.19	7.11	1.26	2.02		
		15	0.39	0.33	3.40	4.88	1.04	1.56		
20	0.5	5	0.74	0.46	1.14	1.79	0.07	0.28	0.28	0.53
		10	0.84	0.49	1.04	1.41	0.03	0.20		
		15	0.92	0.52	1.00	1.25	0.05	0.20		
	1.25	5	0.79	0.52	1.39	2.82	0.17	0.76		
		10	0.86	0.51	1.19	2.16	0.09	0.53		
		15	0.92	0.52	1.10	1.96	0.05	0.42		
	3.0	5	0.44	0.32	3.30	7.73	1.00	2.11		
		10	0.46	0.36	2.50	5.01	0.70	1.51		
		15	0.46	0.38	2.09	3.73	0.54	1.20		

Table 1

References

"Performance of Induction Mixers for Disinfection of Wet Weather Flows: USFilter/Stranco Products Water Champ F Series Chemical Induction System", Environmental Technology Verification Report, pg VS-vii, July 2002, NSF 02/01/EPAWW399

"Performance of Induction Mixers for Disinfection of Wet Weather Flows: The Mastrrr Company: GAS MASTRRR Series 32 Submersible Chemical Induction Mixers", Environmental Technology Verification Report, pg VS-vii, July 2002, NSF 02/02/EPAWW399