FLOW CHARACTERISTICS

OF

HYDROTHANE TRASHRACK ASSEMBLIES

Prepared For

HYDROTHANE SYSTEMS

Prepared By

JOHN C. ROBERGE, P.E.

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INTRODUCTION

The use of coarse bar trashracks on power plant, municipal, industrial and other water intake systems effectively reduces damages to pumps, piping and associated structures and equipment. Steel bar trashracks are extensively employed at such facilities. Vast quantities of empirical data are available to the design engineer for steel bar racks. Idelchik (1966), Handbook of Hydraulic Resistance and D.S. Miller (1968), Internal Flow Systems have evaluated and summarized these data. HYDROTHAEN SYSTEMS has developed a high density polyethylene (DHPE) trashrack bar system which exhibits several potential advantages over steel bar systems. The HDPE racks are highly resistant to corrosion and erosion, but most significantly they demonstrate higher hydraulic efficiency (lower headloss) when compared with typical steel trashracks. The work described in this paper provides the design engineer with basic flow rate – pressure drop data for the HYDROTHANE rack assemblies.

HYDRAULIC PERFORMANCE

The pressure or head drop across a trashrack structure (ΛH) is commonly expressed as a pressure drop coefficient (IK), which is expressed as:

$$IK - \Lambda H/V^2 /2g$$

The pressure drop coefficient is a function of the trashrack Reynolds number and the fractional open area of the rack:

$$IK = f\ (IR, a_r)$$

The tests described in this summary were all conducted using HDPE extruded bars with a thickness of 0.5in and a section depth of 4.0 in. Each bar edge included a moderate radius, thus relieving the rectangular section of any sharp edges. The HYDROTHANE tests were all conducted in flow ranges which yielded Reynolds numbers typically greater than 1×10^4 . It was thus concluded that the principal and most useful expression for the design of an HDPE trashrack would show IK as independent of IR and provided as a plot of IK versus a_r , where:

a_r = Free Cross Section at Bars/Total Cross Section Area

Velocity, V, was measured as the average velocity of the flow stream approaching the trashracks.

HYDROTHANE RACK ASSEMBLY TESTS

A HYDROTHAEN HDPE trashrack assembly was tested in a 1.5 ft x 3.5 ft hydraulic flume to quantify the headloss through the rack as a function of approach velocity (V) and rack area ratio (a_r). The area ration was adjusted by varying the spacing of the trashrack bars. All of the hydraulic flume tests conducted using 0.5 in x 4.0 in (Nom) HDPE radius edged extruded bars.

Headloss (H) across the trashrack test section (s) was measured as a difference between piezometric head upstream versus downstream of the rack(s). Average approach velocity, V, was determined by measuring the total inflow to the test flume and dividing by the measured area of flow.

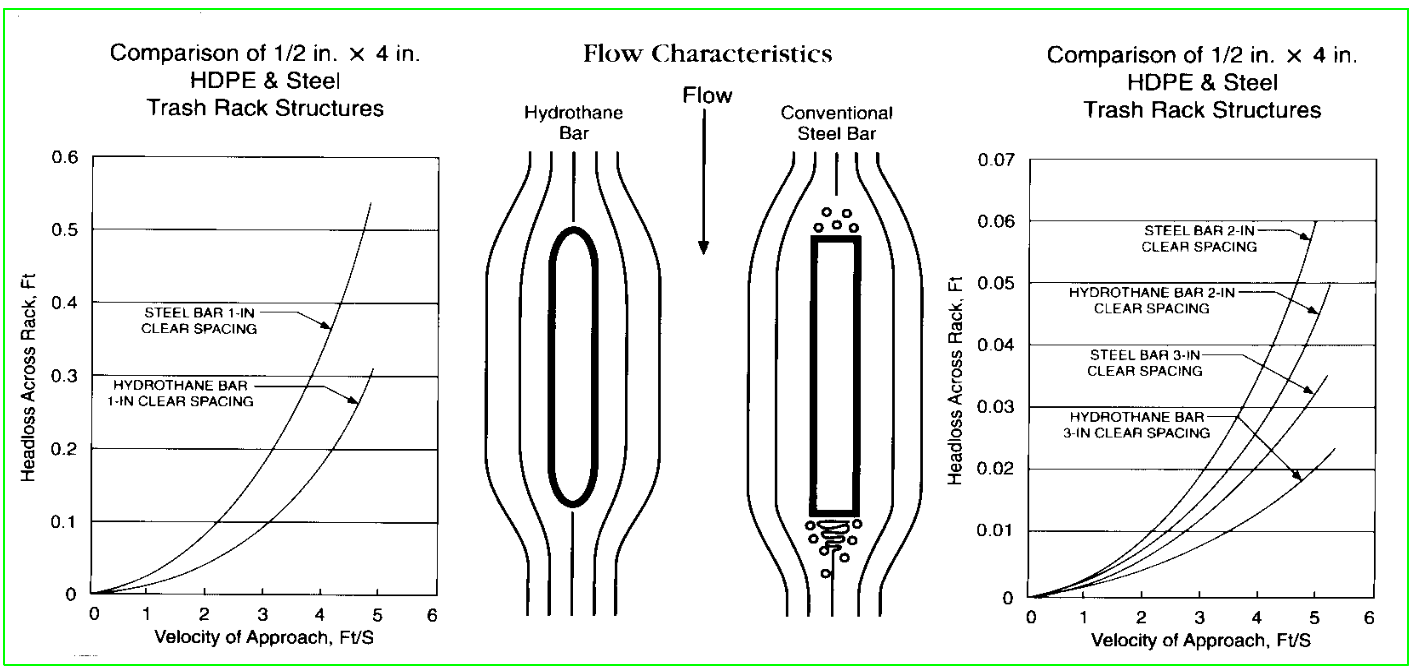
Table 1 is a summary of the test data which was developed for the HYDROTHANE test rack assemblies. These data were averaged for each area ratio, a_r , which was tested. The averaged data points were plotted on the attached plot. This plot included comparison curves for rectangular steel trashrack bars and streamlined steel bar racks.

CONCLUSIONS

The laboratory test results, as summarized on the attached plot, demonstrate that the HYDROTHANE bar rack assembly can provide significantly reduced losses when compared with steel racks of comparable geometry. The potential energy savings were particularly manifested in rack assemblies requiring close bar spacing.

The plot also shows an empirically derived design curve (Miller, 1968) for streamlined steel bar racks. No tests were conducted on streamlined HDPE bars. It could be concluded that streamlining of the HDPE extrusion would result in further decreasing headlosses.

The attached data plot provides design data for engineers and intake structure operators. For any given bar rack geometry (spacing), the anticipated headloss can be determined for the design approach velocity.



HYDROTHANE TEST RACK: HYDRAULIC FLUME TEST											
N	**Flow, cfs**	**h, ft**	**d, ft**	**Total Section Area**	**Free Cross Section**	**Ratio, a/r**	**V, fps**	**K**	**Head Loss, ft**	**H Loss/K**	**Data Average**
5.00	3.040	2.270	3.125	3.393	2.920	0.861	0.896	0.012	0.001	0.080	
5.00	3.600	2.340	3.125	3.498	3.010	0.861	1.029	0.016	0.001	0.061	
5.00	4.250	2.420	3.125	3.617	3.113	0.861	1.175	0.021	0.001	0.047	
5.00	4.710	2.470	3.125	3.692	3.178	0.861	1.276	0.025	0.001	0.040	0.057
7.00	3.120	2.740	2.060	4.096	3.297	0.805	0.762	0.009	0.002	0.222	
7.00	3.190	2.640	2.060	3.946	3.176	0.805	0.808	0.010	0.002	0.197	
7.00	3.510	2.230	2.060	3.333	2.683	0.805	1.053	0.017	0.003	0.174	
7.00	4.130	2.320	2.060	3.468	2.791	0.805	1.191	0.022	0.003	0.036	
7.00	4.510	2.360	2.060	3.528	2.840	0.805	1.278	0.025	0.004	0.158	
7.00	4.850	2.410	2.060	3.602	2.900	0.805	1.346	0.028	0.005	0.178	
7.00	5.440	2.440	2.060	3.647	2.936	0.805	1.492	0.035	0.006	0.174	
7.00	5.130	2.390	2.060	3.573	2.876	0.805	1.436	0.032	0.005	0.156	
7.00	4.990	2.720	2.060	4.066	3.273	0.805	1.227	0.023	0.004	0.171	0.174
10.00	5.560	2.500	1.250	3.737	2.696	0.721	1.488	0.034	0.016	0.465	
10.00	5.880	2.580	1.250	3.857	2.782	0.721	1.525	0.036	0.018	0.499	
10.00	5.440	2.540	1.250	3.797	2.739	0.721	1.433	0.032	0.012	0.376	
10.00	5.220	2.510	1.250	3.752	2.706	0.721	1.391	0.030	0.013	0.433	
10.00	4.290	2.350	1.250	3.513	2.534	0.721	1.221	0.023	0.011	0.475	
10.00	3.820	2.290	1.250	3.423	2.469	0.721	2.116	0.019	0.010	0.517	
10.00	3.460	2.240	1.250	3.348	2.415	0.721	1.033	0.017	0.009	0.543	
10.00	3.460	2.370	1.250	3.543	2.555	0.721	0.977	0.015	0.009	0.608	
10.00	3.330	2.500	1.250	3.737	2.696	0.721	0.891	0.012	0.007	0.568	
10.00	3.180	2.580	1.250	3.857	2.782	0.721	0.825	0.011	0.006	0.568	
10.00	3.120	2.740	1.250	4.096	2.954	0.721	0.762	0.009	0.005	0.555	0.510

NOTE:
(1) All tests were conducted using HYDROTHANE 0.5 IN X 4.0 IN Extruded HDPE radius edge bars
(2) N = No of bars on test rack assembly, flume width = 1.5 FT
(3) Total Cross Section and Free Cross Section Measured in (sqft)