The study of conical flow regulators: the effect of the diameter of the inlet/outlet ports

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Introduction

For over 200 years, a significant increase in the average amount of rainfall has been observed - these amounts range from 80% to 140% of the long-term norm. This is especially the case between May and September, when there are numerous cases of sudden and extremely heavy rainfalls that cause local flooding. These extreme hydrological phenomena have a negative impact on water and sewage management. It is impossible to completely eliminate the effects of too much rainfall, but there are many ways to reduce them. Therefore, engineers are currently facing the challenge of protecting water and sewage management. For this reason, they create solutions that aim to regulate the flow of rainwater. One such solution is the design and implementation of hydrodynamic regulators of various shapes and sizes.

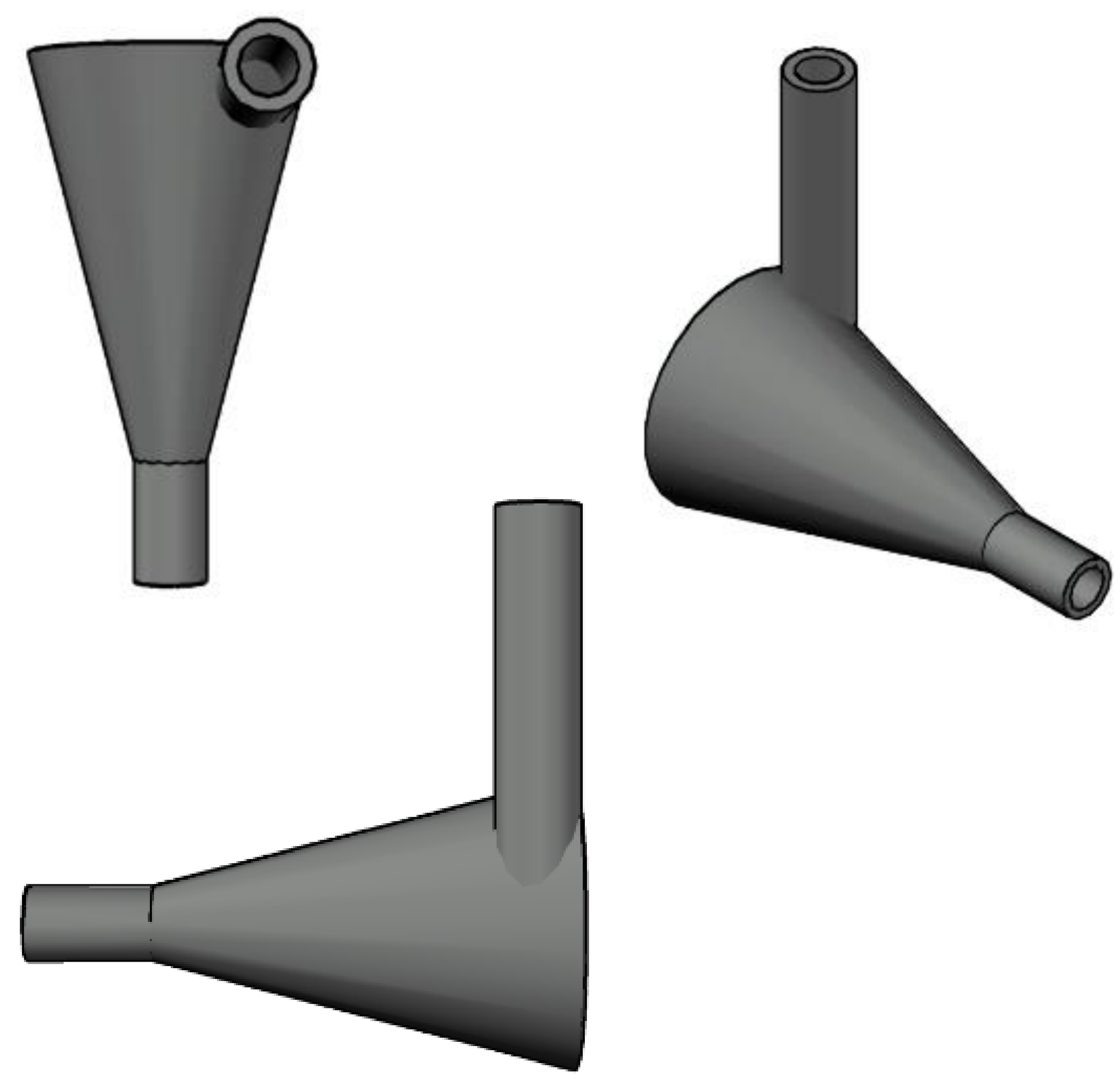

Figure 1. 3D model of a conical flow regulator.

Methodology

Flow regulators are designed and tested on a laboratory scale based on collected experimental data. In order to experimentally determine the characteristics of the liquid flow through the regulator, and to determine the values of the flow coefficient (*m*) and/or local resistance coefficient (*z*), 16 hydrodynamic regulators were designed and printed (Figure 1). They differed in terms of the diameters of the inlet ports d_1 and outlet ports d_2. The data regarding dimensions are listed in Table 1.

Table 1. Characteristics of conical vortex regulators.

Series	d_1 (mm)	d_2 (mm)	h_c (mm)	μ	ζ
1	7.45	7.60	92.30	0.535	3.503
2	7.45	9.45		0.602	2.768
3	7.45	11.65		0.701	2.034
4	7.45	13.75		0.699	2.048
5	9.35	7.60		0.401	6.225
6	9.35	9.45		0.502	3.972
7	9.35	11.65		0.573	3.055
8	9.35	13.75		0.657	2.321
9	11.40	7.60		0.316	10.004
10	11.40	9.45		0.370	7.312
11	11.40	11.65		0.479	4.360
12	11.40	13.75		0.473	4.481
13	13.40	7.60		0.242	17.072
14	13.40	9.45		0.369	7.337
15	13.40	11.65		0.417	5.752
16	13.40	13.75		0.466	4.600

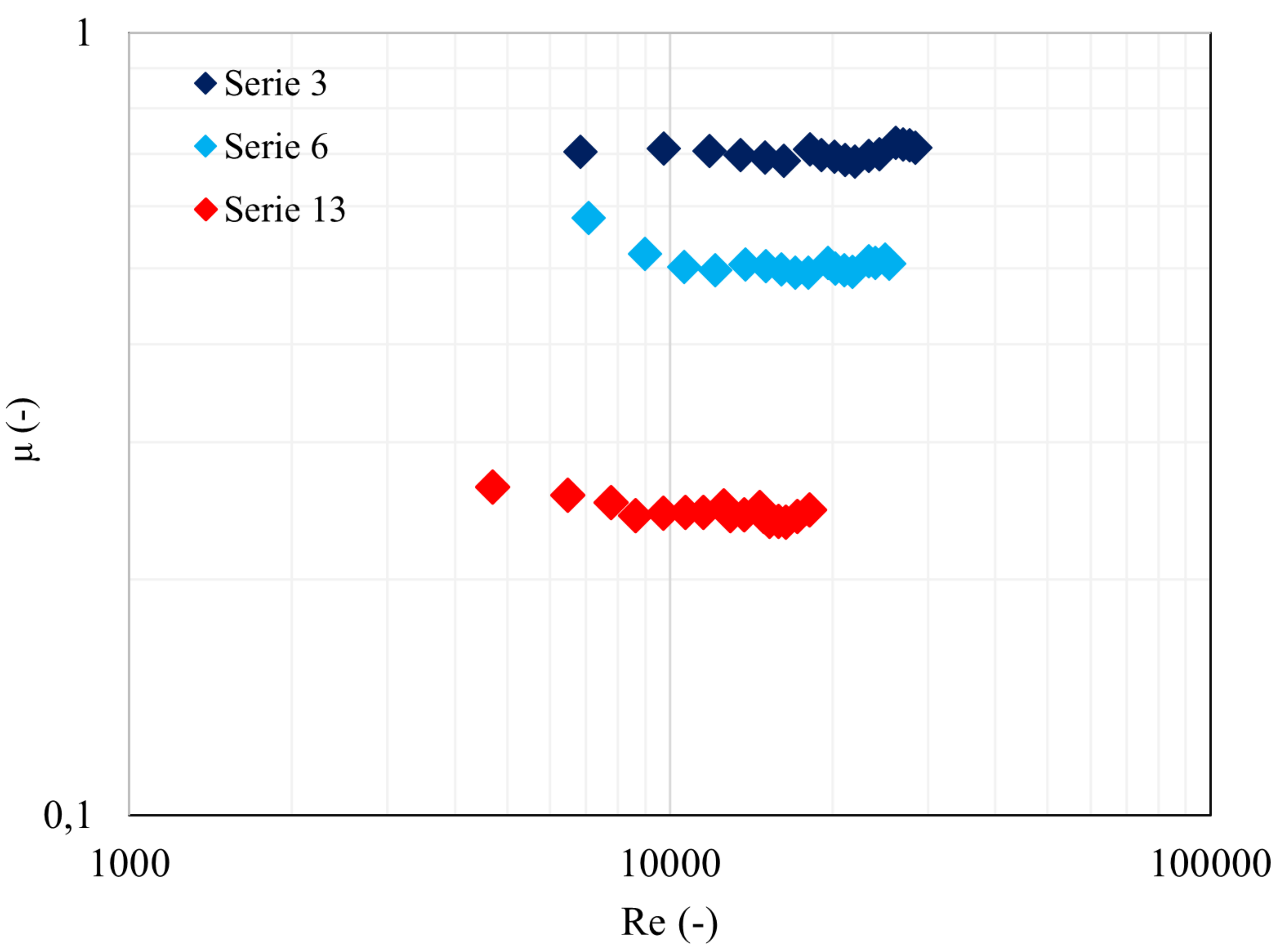

Figure 2. The dependence between μ and *Re*.

Conclusion

As the hydrostatic pressure increased, the amount of liquid flowing through the flow regulator increased. The analysis of the data presented in Figure 2 shows that in the case of large Reynolds numbers, the value of the outflow coefficient is practically constant. The results obtained in the above study may be an introduction to further work on models of flow regulators with different diameters of inlet and outlet ports.

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