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COMMERCIAL, MUNICIPAL, INDUSTRIAL AND RESIDENTIAL

FLOW EQUALIZATION FOR WASTEWATER TREATMENT SYSTEMS

In the past 50 years many advances have been made in the nature and extent of pollution control through the use of improved commercial, municipal, industrial and residential wastewater treatment facilities. Each new refinement and process, while improving overall treatment efficiency, has been hampered by the widely varying nature of wastewater types, strengths and fluctuations in volume. Just in the last 25 years, serious efforts have been undertaken to develop new systems, equipment and components designed to reduce or eliminate the negative effects of volume and strength variations in wastewater. These effects have led to the development and widespread use of flow equalization equipment.

Flow equalization is the process of controlling hydraulic velocity, or flow rate, through a wastewater treatment system. The equalization of flow prevents short term, high volumes of incoming flow, called surges, from forcing solids and organic material out of the treatment process. Flow equalization also controls the flow through each stage of the treatment system, allowing adequate time for the physical, biological and chemical processes to take place.

Published in 1974, the USEPA TECHNOLOGY TRANSFER REPORT states *"The cyclic nature of wastewater flows in terms of volume and strength is well recognized."* It goes on to say *"improved efficiency, reliability and control are possible when physical, biological and chemical processes are operated at or near uniform conditions. For this reason, flow equalization is employed."* Since the mid-1970's, flow equalization has been widely used for commercial, municipal and industrial wastewater treatment systems, both in the design of new facilities and also to modernize and upgrade existing systems.

This technology has only recently begun to be used in residential treatment systems. The flow patterns of residential treatment systems are intermittent and variable in nature, generating frequent hydraulic and organic surges. These surges can result in large quantities of solids being washed out of the system. The SEPTIC SYSTEM OWNER'S GUIDE, published in 1999 by the University of Minnesota Extension Service, states *"for complete and uniform treatment of wastes, the system needs time to work. The ideal situation would be to have wastewater enter the system as evenly as possible throughout the day and week."* The GUIDE continues to explain that when a surge occurs *"suspended solids are carried into the soil treatment system, clogging soil pores and preventing adequate treatment."* In 1970, the National Sanitation Foundation developed a model of daily residential flow patterns for use in testing onsite treatment systems. This model flow pattern, which is still in use today, consists of three periods of concentrated flow, alternating with varied periods of no flow.

This pattern was purposely structured to reflect the most severe flow rate fluctuations that are typical of individual residences. In 1982, a separate test procedure was completed to include stress sequences. These stresses consisted of prolonged no flow periods combined with surge flows several times the daily loading rate. In 1990, the stress sequences were incorporated into the residential flow pattern to reflect the less frequent but more harmful variations in flow that systems may very well experience. A residential treatment system that can reduce these surges and properly process the wastewater will consistently have higher quality effluent and longer operational life.

When flow equalization is incorporated into a wastewater treatment system, numerous benefits are produced:

1. In the case of a septic tank or pretreatment tank, gravity separation of solids is greatly enhanced. This prevents short-circuiting and eliminates excess solids from being carried downstream into the secondary treatment facility or disposal system.
2. When a secondary biological or chemical treatment system is used, elimination of hydraulic surges guarantees adequate process retention time and a much higher degree of treatment.
3. Clarifiers following secondary treatment will have greater solids separation and improved effluent quality. If an internal filtration device is used, solids loading to the filtration device will be reduced, resulting in longer filter life and higher effluent quality.
4. The operation of a downstream sand filter, media filter or constructed wetland is enhanced by more consistent loading, the equalization of surge flows and the removal of excess solids.
5. All types of effluent disposal systems, including tile fields, mounds, irrigation systems, etc., will operate longer and more efficiently because organic and hydraulic surges are eliminated and system overloading is prevented.

FLOW EQUALIZATION FOR WASTEWATER TREATMENT SYSTEMS (Cont.)

Norweco's patented Bio-Kinetic System incorporates non-mechanical flow equalization, effluent filtration, settling, solids storage and chemical addition in one easily installed assembly that is serviceable from grade. The system provides flow equalization for wastewater treatment systems without the use of pumps or holding tanks, with no moving parts and no electricity required. This is accomplished by storing incoming flow surges in the upstream treatment tank. Six flow control ports in the Bio-Kinetic System meter the stored liquid through all treatment processes at a controlled rate. In a typical septic system, daily residential flow is equalized an average of more than 50% when a Bio-Kinetic System is used. This revolutionary device is an integral component of the Singulair Wastewater Treatment Plant. In addition, the Bio-Kinetic System can be easily incorporated into any onsite treatment and disposal process through the use of a Bio-Kinetic Wastewater Management System.

EFFECTS OF FLOW EQUALIZATION ON TREATMENT PROCESSES UTILIZING TYPICAL HYDRAULIC LOADING PATTERNS WITH A BIO-KINETIC SYSTEM

TREATMENT COMPONENT	RATED CAPACITY (GPD)	ACTUAL HOLDING CAPACITY	AVG PROCESS FLOWRATE WITHOUT FLOW EQUALIZATION	AVG PROCESS FLOWRATE WITH FLOW EQUALIZATION	AVG EQUALIZATION PERCENT	AVG DETENTION TIME WITHOUT FLOW EQUALIZATION	AVG DETENTION TIME WITH FLOW EQUALIZATION	AVG INCREASE IN COMPONENT DETENTION TIME PERCENT
SEPTIC TANK	500	1,500 gallons	0.926 GPM	0.457 GPM	50.6%	27.0 HRS	54.7 HRS	102%
SEPTIC TANK	1,000	2,500 gallons	1.852 GPM	0.814 GPM	56.0%	22.5 HRS	51.2 HRS	127%
SEPTIC TANK	1,500	4,000 gallons	2.778 GPM	1.158 GPM	58.3%	24.0 HRS	57.6 HRS	140%
SEPTIC TANK	2,000	5,000 gallons	3.704 GPM	1.468 GPM	60.3%	22.5 HRS	56.8 HRS	152%
DOWNSTREAM TILE FIELD (typical)	500	500 lineal feet	0.926 GPM	0.457 GPM	50.6%	5.9 HRS (theoretical)	11.9 HRS (theoretical)	102%
DOWNSTREAM MOUND (typical)	500	50 lineal feet	0.926 GPM	0.457 GPM	50.6%	0.6 HRS (theoretical)	1.2 HRS (theoretical)	100%
DOWNSTREAM SUBSURFACE SAND FILTER	1,000	870 square feet	1.852 GPM	0.814 GPM	56.0%	234.2 HRS (theoretical)	533.0 HRS (theoretical)	127%
DOWNSTREAM SURFACE SAND FILTER	1,500	60 square feet	2.778 GPM	1.158 GPM	58.3%	8.1 HRS (theoretical)	19.4 HRS (theoretical)	139%
AEROBIC SYSTEM	600	1,300 gallons	1.111 GPM	0.553 GPM	50.2%	19.5 HRS	39.2 HRS	101%
AEROBIC SYSTEM	1,000	2,200 gallons	1.852 GPM	0.767 GPM	58.6%	19.8 HRS	47.8 HRS	141%
AEROBIC SYSTEM	1,500	2,400 gallons	2.778 GPM	1.125 GPM	59.5%	14.4 HRS	35.5 HRS	146%
AEROBIC SYSTEM	2,000	4,300 gallons	3.704 GPM	1.399 GPM	62.2%	19.3 HRS	51.2 HRS	165%
AEROBIC SYSTEM PRETREATMENT	600	450 gallons	1.111 GPM	0.553 GPM	50.2%	6.7 HRS	13.5 HRS	101%
AEROBIC SYSTEM AERATION	600	600 gallons	1.111 GPM	0.553 GPM	50.2%	9.0 HRS	18.1 HRS	101%
AEROBIC SYSTEM CLARFICATION	600	250 gallons	1.111 GPM	0.553 GPM	50.2%	3.7 HRS	7.5 HRS	103%
DOWNSTREAM CHLORINE CONTACT	600	50 gallons	1.111 GPM	0.553 GPM	50.2%	0.7 HRS	1.5 HRS	114%
DOWNSTREAM CHLORINE CONTACT	1,000	100 gallons	1.852 GPM	0.767 GPM	58.6%	0.9 HRS	2.2 HRS	144%
DOWNSTREAM CHLORINE CONTACT	1,500	150 gallons	2.778 GPM	1.125 GPM	59.5%	0.9 HRS	2.2 HRS	144%

The above chart clearly demonstrates the important role flow equalization plays in wastewater treatment. Incorporating flow equalization into residential onsite treatment systems makes any system perform better and prevents premature failure. Hydraulic surges are produced in the home every day through the combined use of bathtubs, dishwashers, disposals, clothes washers, shower facilities and a variety of other water using appliances. When these surges occur, a residential treatment system without flow equalization is compromised and often will not provide adequate treatment. Flow equalization allows commercial, municipal, industrial and residential wastewater systems to deliver the treatment they were designed to provide.

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