White Paper on Side Streams, Nutrient Recovery and the TerraNew Process

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INTRODUCTION

The Clean Water Act of 1972 (later amended in 1977) was an improvement on the Federal Water Pollution Control Act of 1948 and was enacted to control pollution of the nation's waterways. This promoted the improvement of existing wastewater treatment systems and required the treatment and permitting of point sources of pollution such as Publicly Owned Treatment Works. These early treatment facilities focused primarily on Biological Oxygen Demand (BOD) and Total Suspended Solids (TSS) removal. State and Federal discharge requirements in recent years have become increasingly more limiting, especially as they relate to nutrient removal. Fortunately technology is improving to meet these nutrient removal requirements.

Regardless of the processes employed, wastewater treatment plants are successful at physically, biologically and chemically removing pollutants from wastewater. From a simplified physical standpoint, the end product is treated water and biosolids. Looking at the overall process, there is a lot of skimming, pressing, separation, clarification, recirculation and settling that takes place at various stages. Each one of these additional internal processes creates a waste stream that must be further treated or returned to the treatment process before ending up with the final products of water and biosolids.

Being able to remove (and recycle) nutrients and pollutants from "internal" waste streams at a treatment plant is becoming more appealing as discharge permit parameters become more limiting on what a treatment plant can discharge, especially in the way of nutrients. This paper will discuss the following:

- What are side streams?
- What costs are associated with treating side streams?
- What potential for nutrient recovery lies in side streams?
- TerraNew's Technology for side stream treatment.

WHAT ARE SIDE STREAMS?

The wastewater treatment process can be broken down into several smaller processes that each serve the function of separating and treating pollutants in the waste stream. For the sake of this paper, we will consider a side stream to include any by-product of a process that requires further treatment or disposal. These side streams typically are returned to the treatment process, or might be considered part of the main stream of treatment, but they still require some form of additional treatment. A traditional treatment facility might produce any one of the following potential side streams from their various processes:

- Headworks Process: One might not consider this process as having a side stream. Separation at this stage of the process is the physical removal of the debris and grit that are common in wastewater. Traditional disposal for these products is landfilling or incinerating. Nutrient recovery or removal is not a consideration at this stage.

- Clarifiers (primary and secondary): Primary clarifiers separate solids that settle readily from the beginning of treatment. This raw sludge side stream tends to be very high in BOD and TSS and is typically sent for further treatment in an anaerobic or aerobic process. Water from primary clarifiers requires further treatment as well in some form of biological process. Secondary clarifiers are typically used after a biological process; such as a trickling filter, oxidation ditch, or bioreactor. With an oxidation ditch or bioreactor, a secondary clarifier is used to separate the biomass from the water through settling. This biomass is then reused, as it contains microorganisms critical for treatment, and a portion could be considered a side stream that must be wasted from the system and requires either disposal, dewatering and/or further treatment. Secondary clarifiers are one of the final processes of treatment, and the water leaving the clarifier will undergo either filtration and/or disinfection prior to discharge.
- Digestion: Digestion as it relates to wastewater treatment refers to the biological breakdown of mass either through an anaerobic or aerobic process. This process sometimes requires specific temperatures and detention times as well as the proper environment to allow the microorganisms to work. One result of this process is excess decant or a supernatant side stream water that needs to be removed; this is done to concentrate the sludge as well as decrease energy requirements with heating.
- Dewatering: Dewatering is the process by which sludge is mixed with a polymer and the water is forced, typically mechanically, from a waste stream that is semi-high in solids to further increase its solids content. Dewatering processes therefore will have a side stream of water that has been removed from the sludge as well as any wash water that is used on the mechanism being employed.
- Filtration: The filtration process will always have a side stream of backwash water containing what has been filtered from the water. Flows that have BOD, TSS, and nutrient content will require further treatment.

WHAT COSTS ARE ASSOCIATED WITH TREATING SIDE STREAMS?

Treatment plants are typically designed to allow for internal treatment of all of the above mentioned side streams; therefore, various stages in a treatment process are naturally upsized to account and allow for this**.** There are also specific processes and equipment at treatment plants to process side streams. For example, treatment plants might build additional digesters, tanks, basins, or other storage structures for the purpose of holding reject water or sludge from digesters, dewatering, filtration and sludge wasting while it is awaiting disposal or treatment. Also, the sole purpose of dewatering equipment is to concentrate sludge and decrease its volume for hauling, disposal or further treatment. The current industry mind set is to concentrate, increase percent solids, and reduce the volume and weight of biosolid waste streams. To help think outside the box the following questions should be considered

- Could the capital cost, scope, or size of a treatment plant construction or remodel be decreased by eliminating or diverting side streams out of the system rather than returning them to the process?
- What equipment is currently in place to deal with one or more of these side streams that could be removed? Would this have a ripple effect on things such as hauling costs and disposal fees?
- If excess water from side streams did not have to be removed, what expense would be saved? If a side stream is high in nutrients, what is the cost associated with re-introducing it into the process only to have to remove it again later?
- What would it be worth to avoid expansion, equipment purchase, or process changes?

WHAT POTENTIAL FOR NUTRIENT RECOVERY LIES IN SIDE STREAMS?

The beneficial use of biosolids should be considered not only from an environmental standpoint, but from an economic one as well. It is simply the right thing to do. This mindset will help the wastewater industry as it moves into the age of not only nutrient removal, but nutrient recovery and subsequent use. Nutrient recovery from side streams is a proactive approach to eventually address nutrient removal from treatment plant effluents. Below is a list of three common side streams and an example of their potential nutrient and pollutant content:

Digester Supernatant:

Compound	High mg/l	Low mg/l
COD Total	9,000	700
COD Soluble	2,000	200
BOD Total	4,000	300
BOD Soluble	1,000	100
N Total	800	120
Ammonia N	500	100
P Total	300	15
TSS	10,000	500
VSS	6,000	250
H2S	20	2

Dewatering Liquid:

Compound	High mg/l	Low mg/l
COD Total	4,000	800
COD Soluble	3,000	600
BOD Total	1,500	300
BOD Soluble	1,000	250
N Total	500	100
Ammonia N	450	95
P Total	20	5
TSS	1,000	100
VSS	600	60
H2S	20	0.2

Filtrate:

Compound	High mg/l	Low mg/l
COD Total	1500	300
COD Soluble	200	40
BOD Total	400	50
BOD Soluble	30	10
N Total	100	25
Ammonia N	10	1
P Total	50	5
TSS	1500	300
VSS	900	150
H2S	0.1	1.01

References for tables:

© 2008 Mogens Henze. Biological Wastewater Treatment: Principles Modelling and Design. Edited by M. Henze, M.C.M. van Loosdrecht, G.A. Ekama and D. Brdjanovic. ISBN: 9781843391883. Published by IWA Publishing, London, UK.

TerraNew'S TECHNOLOGY FOR TREATING SIDE STREAMS

TerraNew offers a technology that has the ability to treat various side streams and recover the valuable nutrients they contain. This will be beneficial in two ways: first, it will eliminate nutrients from being reintroduced into the treatment process. When side streams that have high nutrient or pollutant concentrations are reintroduced into a treatment plant there is the potential to cause an upset in the treatment process. If this concentration is high enough, there is also the risk of nutrients not being completely treated in the process and then leaving in the plant's effluent. Second, TerraNew's process recovers nutrients as a beneficial product.

Treatment plants are designed to treat many of these pollutants and nutrients biologically and chemically. If the choice is made to reintroduce these sides streams back into the treatment process, care should be taken to ensure that it does not create a shock to the treatment process based on the concentration and volume of the side stream. TerraNew's technology allows these side streams to be treated independent of the treatment process to avoid any potential upset or issue with nutrient discharge limits that could be caused by introducing them back into the process.

SUMMARY

There is a need in the wastewater industry to address nutrient removal and recovery. Many of these nutrients are present in side streams that are generated internally at treatment plants. TerraNew offers a viable alternative to the reintroduction of these side streams back into the treatment process. TerraNew's technology has the ability to do this on site and immediately after the nutrients have been removed by the initial treatment process. TerraNew has the ability to transform wastes from a variety of side stream sources; the waste does not need to be concentrated or have high percent solids to be processed using TerraNew's equipment.

For further information, please refer to these additional white papers on our web site:

Exceptional Quality and the TerraNew Process and

Land Application of TerraNew Processed Biosolids

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