Why this Topic: I'm Living in Kashmir region (state of Jammu and Kashmir) in northern India. Kashmir's Chilly weather in winter (temperature drops approx. to minus 6 Deg.Celsius) does not suite all the recently installed wastewater treatment plants and are not performing to the standard. So the idea comes to me to write on; what could be the reasons for this non-performance in cold climates.

If anyone who reads this topic and share their experience would be appreciated.

Solving Operation Problems for wastewater treatment Plants in Cold Climate.

The primary element in the majority of direct discharge wastewater treatment facilities is the biological treatment plant. In biological treatment the organic pollutants in the waste are biodegraded and converted to carbon dioxide and water. The performance of the organisms responsible for this degradation is significantly impacted by changes in wastewater temperature.

To overcome the operation problems experienced in biological wastewater treatment in cold winter weather conditions, there have been numerous articles describing the kinetic relationships of biological treatment. Eckefelder has nicely described the kinetic relationship of bio-degradtion which can assist the plant operators.

$(So – Se) / (X\ t\ K) = Se/So$

Where:

So = Influent BOD (mg/L)

Se = Effluent BOD (mg/L)

X = MLVSS (mg/L)

t = detention time (days)

K = Reaction Rate Coefficient (day-1)

The factor K is the kinetic rate coefficient and has been found to be related to temperature.

This variation with temperature can be described by the relationship:

$K_T = K_{20}\ \theta^{(T-20)}$

Where:

θ = temperature coefficient (typically 1.02 to 1.08)

T = Temperature (°C)

Using the type of organisms typically found in municipal and industrial wastewater treatment facilities, the optimum treatment plant performance is found in the temperature range of 20°C to 35°C. At temperatures above 35°C we begin to see deterioration in the biological floc as the facilities begin to experience problems with settling and solids - liquid separation. However, the most common temperature problem is related to cold temperature and winter operation. Under these conditions there is reduced biological activity which can result in a deterioration of treatment quality and exceedances of permit limitations. As a "rule of thumb", the rate of biological activity and treatment doubles with each 10°C rise in wastewater temperature or, conversely, is cut in half with each 10°C drop. At wastewater temperatures below 5°C biological treatment activity drops to near zero. As in Kashmir region (India) the temperature drops below - 6°C in winter. To minimize problems with biological wastewater treatment, the wastewater temperature in the biological processes should be maintained above 10°C throughout the year.

Temperature Models

To assist the engineers and operations in evaluating temperature control modifications, it is useful to employ a temperature model. There are a number of temperature models which are available to predict the basin temperatures. Based on our operational experience and online resources available we have found these models to be effective in evaluating basin temperature and implementing control technologies. Some of the primary the factors which affect basin temperature are shown in Figure below:

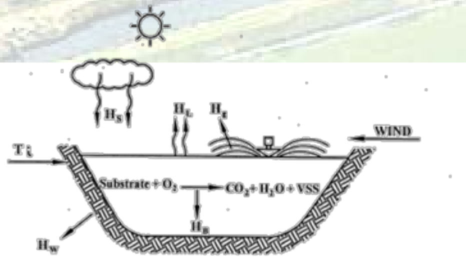


Figure 1: Factors affecting aeration basin Temperature

There are a number of alternatives available to engineers and operators to overcome problems related to cold temperature operation. These controls can be categorized as follows:

a) Increase Wastewater Temperature
b) Increase Biological Activity
c) Reduce Waste loading

Increasing Aeration Bain Temperature

Prevent Heat Transfer, the primary mechanism for heat loss through conductive and evaporative losses is aeration. Mechanical surface aeration results in significantly greater heat loss than diffused aeration. Figure 1 presents a schematic of the mechanisms for heat loss. To reduce this temperature loss there are several aeration approaches. These include:

- Adding Mixers to Aeration Basin: provide up to a 90% reduction in power requirements from surface aerators and which can provide the necessary energy or mixing of the basin while minimizing surface agitation and heat loss.
- Use a low profile modification on the surface aerators. In this case the cross sectional areas of surface spray is reduced so that there is less evaporation and temperature loss.
- Reduced aeration during periods of extreme cold, major temperature loss occurs on cold winter nights. Although there would be some reduction in treatment efficiency during this compromised mode of operation, the maintenance of a higher overall temperature in the basin but allows better overall biological treatment performance.
- Modification of the aeration system from surface aeration to diffused aeration.
- Insulation of tank wells and install tank covers (fixed or floating roof).

Heating the Basin

Another approach is to add heat to the basin. The injection of steam or hot water either into the aeration basin or into the raw waste ahead of the aeration basin can increase the basin temperature. This model seems to be expensive however such models have been found in many industries where effluent stringent effluent standard has to be maintained throughout the year in cold climate areas.

Nutrient Addition

Generally, there is adequate activity of the organisms to produce the desired treatment level without the need to increase biological activity. However there are some options for increasing biological activity. For example, in many cases, we have found the kinetics to be nutrient limited. In these cases, it may be possible to increase the reaction rate, by adding desired nutrients. In this case, the increase in reaction rate because of nutrients will be more and compensate for the reduction in reaction rate because of cold temperature and the system can perform under both winter and summer conditions. There have been a number of treatment plants which have found it necessary to increase nutrient addition under winter conditions.

Waste load Reduction

To bring the treatment plant into compliance under cold temperature conditions waste load to the biological system is reduced.
To achieve this objective the supplemental addition of powdered activated carbon to the aeration basin under cold temperature conditions would be possibly adsorb some of the organics rather than biodegrade these organics. The adsorbed organics could then be removed and disposed with the sludge handling system. This would reduce the load on the biological system and allow more consistent compliance under winter operations

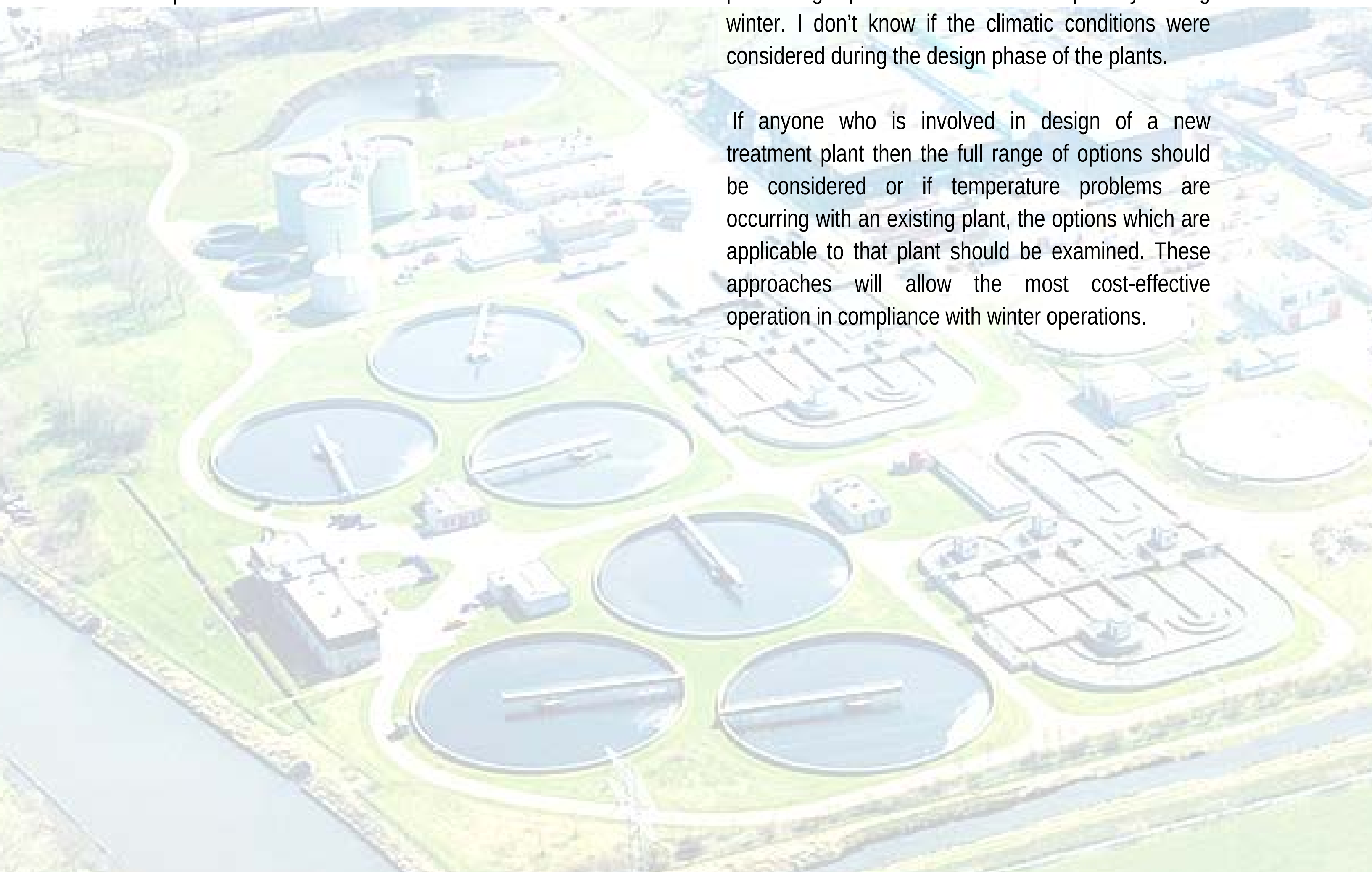
Another way to reduce waste loads would be to pretreat the waste under winter conditions. For example, coagulation or dissolved air floatation, it may be possible to increase coagulant dosages under winter

Operations and break out more of the organic load. This would then reduce the loading to the biological treatment process and allow more consistent winter operation.

CONCLUSION

Temperature plays a major role in the performance of biological treatment plants. However, there are number of approaches available to the engineer and operators which can be utilized to control temperature. As per the information's available the wastewater treatment plants in Kashmir (India) not performing up to the standards especially during winter. I don't know if the climatic conditions were considered during the design phase of the plants.

If anyone who is involved in design of a new treatment plant then the full range of options should be considered or if temperature problems are occurring with an existing plant, the options which are applicable to that plant should be examined. These approaches will allow the most cost-effective operation in compliance with winter operations.



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