# Oxidation Pond Design.

16-27) Use EPA design tables.
Average winter temperature = 16°C.
$Q_{avg.}$ = 3,800 $m^3/d$
$BOD_5$ = 100.0 mg/L = 100 $g/m^3$
3 cells in series.
min. depth = 0.6 m to prevent plant growth.

Table 16-10) Allow BOD loading = 45 kg/ha·d

$$A_{mean\ total} = \frac{3{,}800\ \frac{m^3}{d} \times 100\ \frac{g}{m^3} \times \frac{kg}{1000\ g}}{45\ \frac{kg}{ha \cdot d}} = 8.44\ ha$$

8.44/3 = 2.81 ha/cell

$$\text{Loading to primary cell} = \frac{3{,}800\ \frac{m^3}{d} \times 100\ \frac{g}{m^3} \times \frac{kg}{1000\ g}}{2.81\ ha} = 135\ \frac{kg}{d \cdot ha}$$

Table 16-10) 135 kg/ha·d is within range — 135 to 202 $\frac{kg}{d \cdot ha}$

Table 16-11) Let detention time = 40 days total.
This gives 13.3 days / cell.
use 14 days per cell conservatively and to avoid a fraction of a day.

Table 16-11) Primary cell detention range is 5 to 15 days
so 14 days detention is acceptable.

$$\text{Average depth} = \frac{V_{avg.}}{A_{avg.}} = \frac{3{,}800\ \frac{m^3}{d} \times (14 \times 3\ \text{days})}{8.44\ ha \times \frac{10{,}000\ m^2}{ha}} = \frac{42\ \text{days}}{} = 1.89\ m.$$

This average depth will be too much as it will make the max. operating depth = 2(1.89) + 0.6 = 4.38 m. but max. water depth in primary cell is only 1.2 m including depth for storage of sludge.

16-27) continued.

Tab 6 16-12 gives max. cell depth up to 1-5 m for 2nd and 3rd cells, but only 1.2 m for primary cell. 16°C is close to 15°C which would allow up to 1.5 m depth in the 0°C – 15°C temperature range for the primary cell. At higher temps. there is no problem of heat loss and shallower depths will mean a greater aerobic zone. There will be greater BOD loading to the primary cell so I think a max depth (excluding sludge zone) is best limited to 1.2 m for cell #1, and make all cells the same size for simplicity.

This gives 1.2m – 0.6 m = 0.6 m between the min. and max. operating depth levels, or only 0.3 m at the average operating depth. So increase cell areas to give an average depth of 0.3 m.

$$\text{Average area} = \frac{V_{avg}}{\text{avg depth}} = \frac{3{,}800\ \frac{m^3}{d} \times 42\ d}{0.3\ m} = 532{,}000\ m^2$$

$$532{,}000\ m^2 \times \frac{1\ ha}{10{,}000\ m^2} = 53.2\ ha \text{ for 3 cells}$$

or 17.73 ha / cell.

GLUMRB recommends 16 ha/cell max.

Try 16 ha/cell and get the average depth.

$$\text{Average depth} = \frac{V_{avg.}}{A_{avg}} = \frac{3{,}800\ \frac{m^3}{d} \times 42\ d}{3\ \text{cells} \times 16\ \frac{ha}{\text{cell}} \times 10{,}000\ m^2/Ha} = 0.332\ m.$$

Let average depth = 0.34 m.

16-27) continued

For cells without sludge storage:

Mean operating depth = 0.332 m + 0.6 m = 0.932 m.

Max. operating depth = 2(0.332 m) + 0.6 m = 1.264
≅ 1.27 m.
can peg 1.3 m.*

This is only slightly greater than the recommended depth so considered to be acceptable.

1.30 m + 0.9 m freeboard = 2.2 m.

Width of cells if square = $(16\ ha \times 10{,}000\ m^2/ha)^{1/2}$

= 400 m.

For primary cell: Total cell depth from Table 16-12 is 1.5 to 2.7 m.

Select near higher level, use 2.7 m

2.7 m − 1.3 m = 1.4 m.

So allow sludge depth = 1.4 m.

Max depth with sludge = 1.3 m + 1.4 m = 2.7 m.
(max operating depth; sludge depth)

2.7 m + 0.9 m freeboard = 3.6 m.

* Table 16-12 rounds all depths off to the nearest 10 cm.