

# BNR/ENR Selector Setup (flow thru processes)

## Example - 5 Stage Bardenpho Process Setup (page 1)

(Use as a general guide only)

BNR --- Effluent 5-8 mg/L TN; <2.0 mg/L TP

ENR --- Effluent < 3 mg/L TN; <0.6 mg/L TP

Stricter ENR TP requirements may require additional treatment such as Filtration.

- Anaerobic Selector (1.5 hours HRT) *(BNR/ENR variations 0.5 to 2.0 hrs.)*
  - Used for Bio-P Removal
  - D. O. and Nitrate as low as possible
    - Minimize Nitrates and Oxygen in recycle flows
  - Removes and requires Carbon
    - cBOD5 to TP ratio is important to maintain (20 to 25 to 1)
    - some designs require 10 lbs. (bio-gradable soluble) COD to 1 lb of TP
  - Monitor side streams such as dewatering filtrate and digester decant that contains Phosphorous
  
- Anoxic Selector (3.0 hours HRT) *(BNR/ENR variations 0.5 to 4.0 hrs.)*  
*(2021 MDE Guidelines 2-4 hrs.)*
  - Used for Denitrification.
  - Consumes a portion of available BOD
    - cBOD5 to TKN ratio is important to maintain (3.0 - 4.0 to 1)
  - Internal Recycle (200 to 400%)
    - Keep dissolved oxygen levels low in all recycle and side stream flows entering selector
  - Complete Mixing Required and multiple smaller reactors are known to improve Denitrification over the use of 1 full size reactor
  - Simultaneous Nitrification/Denitrification possible with oversized selectors, higher MLSS and
    - 0.3 – 0.7 mg/L D. O. (recommended range varies)
    - ORP – 50 to + 125 mV (recommended range varies)

# BNR/ENR Selector Setup (flow thru processes)

## Example - 5 Stage Bardenpho Process Setup (page 2)

- 1<sup>st</sup> Aerobic Selector (12.0 hours HRT) (*typically BNR/ENR 12.0 to 20.0 hrs. HRT*)  
(2021 MDE Guidelines 8-12 hrs.)
  - Typically sized for BOD removal in the first 4 to 8 hours then Nitrification follows.
  - D. O. Levels tightly controlled to avoid high D. O. in recycle and return flows
    - Higher front end D. O. level > 2.0 mg/L to enhance Bio-P removal
    - Then tapering off D. O. levels to reduce D. O. in recycle
      - simultaneous nitrification/de-nitrification is sometimes promoted by tapering off D.O. levels to (0.3 to 0.7 mg/L)
- 2<sup>nd</sup> Anoxic Selector (2.0 hours HRT) (*BNR/ENR variations 1.5 to 4.0 hrs.*)  
(2021 MDE Guidelines 2-5 hrs.)
  - Clean carbon source is almost always required to achieve ENR level of treatment.
  - The Clean Carbon Source is normally added to the 2<sup>nd</sup> Anoxic Selector.
- 2<sup>nd</sup> Aerobic Selector (30 minutes) (*BNR/ENR variations 0.5 to 1.0 hrs.*)  
(2021 MDE Guidelines 0.5 to 1.0 hrs.)
  - Return to oxic conditions before clarifiers.
  - Course bubble aeration can promote N<sub>2</sub> gas release by breaking up floc.

**2021 MDE Guidelines Recommends a Total HRT of 16 to 23 hours for 4-Stage Bardenpho Processes. However, for facilities with high BOD loading and no Primary Treatment the 23 hours HRT is recommended.**

**Additional MDE Guidelines for 4-Stage Bardenpho Processes:**

**MLSS 3,000 – 5,000 mg/L**

**MCET 10-40 days**

**F/M Ratio 0.1 to 0.2**

**RAS (% of Forward flow) 100%**

**Internal Mixed Liquor Recycle 400% to 600%**