

1WC-13-47

The Thermal ZLD Experience for FGD Wastwater at PSNH's Merrimack Station.

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 Burns + McDonald. BS - Mech Eng
 Tisha
 Tatum + Merrimack
 BS - Chem Eng. Mason FE - ME + II

Risk

Clean Air project.
 NH leg. concerned w/ Hg
 Result, crafted law - to install WET FGD up & oper. by July 2013 - key pt.
 if not must shut down.
 NGV etc 50x as well.

2012 plant 120 MW Unit 1 - cyc. & limestone ball mills. absorber gypsum dry fire tables & storage build.
 settling ponds
 sell as byproduct.

340 MW Unit 2.

slay. water - nitrate - absorber - physchem etc.

Get approval from NHDEC & then to EPA (to sign off?)
 "Permit writer kept nodding his head & going along"

Hg evergreen background amount + net metals reduction overwater

2010 - up & going every component - exactly as approved & done w/ DEIS.

Famos meeting w/ EPA - Nov. 2010
 they asked us ZLD is up & running.
 we said no.
 but is at Intertec - we are going to consult for MS.

Start talking ZLD - long protractual process

March out to bid Jan 1st order contract.

Aug - all build. mater.

Sept. 30 2012 ZLD on-site - all 1st effect.

was going to copy Iatan's system. - wanted to mix w/ fly ash

Sept. 30
Feb 3, 2012 first effect equip on-site.
first effluent to ZLD

rough max @ 7.
don't land fill
on-site. - discharge
to add
crystallizer

May 22, 2012 ZLD 1st eff. perf. test.

June 20, 2012 solids gen. from 2nd eff.

Aug 8, 2012 second eff ZLD perf. test.

1 year all onsite - driven by schedule.

Trash

disaster w/ schedule

1st effect chems - did not require softening, not required

2nd " " - partially softened.

2X 100% phr/chem - reaction tanks clarifiers polishing system.
↳ typical. end. H₂ & H₂S removal.

we did remove redundancies became 2X 50%.

tanks in IP - went to M series.

H₂/H₂S required backwash water. w/ pH not meet req. of ZLD.

so drop pH send over to evap. system.

Seeded system - from phr/chem

preheater → deaerator → evap sump.

heat exch. dist. from evap/cool.

↳ gear pump to top of evap - 70 ft.

tube sheet @ top - v. fine steam network of vertical tubes.

↓ 40 ft increase in temp.

Sump - mist eliminators. - v. compressor (heat press. slightly)

exterior sides of tubes - energy trans. back to recir.

distillate (pond of outside) → tank. (stripping steam for deaerator & heat feed stream)

Hydrocyclone^{op lowers} - storage tank to feed crys.

65 gpm 10,000 CL at inlet.

8 gpm conc. brine from evap. - control quantities.

1st effect → flash tank
2nd " " storage tank - cook 24 hrs. May/June 2012 steam vaporized sent to condenser for on 1st eff. skin -

The boiler FGD tilted 7.

reused preheater. went to makeup water to scrubber so recir am. need in "

1st eff. 3 gpm → conc. tank → used for fly ash wetting. Couple months until 2nd eff. oper. heat vapor used from 1st to 2nd so 2nd uses less energy. more materials less energy.

index belt filter

solids - dumpster
filtrate → back to 2nd effect
single train evap → 1st - 2nd eff. → heat exchanger
concentrated tank. squeezed into build.

salt cake - perf. test

Rock - challenges.

Schedule huge steel designed separately - week built. (last shipment 0013.)

2nd eff. → safety net - go to full ZLD.

haven't done alot of brine mixing - push chem. to salt cake.

Phys chem designed to capture major of metals \rightarrow to
soft so disposing of NaCl. landfills

pH - ext. import.

Contract side - put 1 tank from prim + sec. system
evap \rightarrow pH got to watch.

antifoam agent pH \uparrow 9.0 - soap or
"volumetric foam"
happened 2x team together.

1 wk - ~~m~~ evap didn't need antifoam,
still see in crystal.

don't want to go to low w/pH as water.
softening chall.

1st plant to add soft. after phys chem
"partial soft" ^{add} Na system (tank) \rightarrow soda ash.

import redundancies
adding solids \rightarrow

Solid phase sulfates \rightarrow got to drop out.
Na₂SO₄ - work of densit

plugged heat exchangers deaur. evap.

team together (jar tests on site) vendor
eng.

Just turn agitators off - let settle out solid phase
SO₄ drop out.

only
soft
phase
114 soft

1000 ppm

leave enough Ca in
system so making Ca sulfate.

Worked extremely well.

"once get chem right - this stuff is fine"

chell.

ZLD does not mean zero liquid - liq all over the place.
chem balance import.
only place

✓ testing? ^{why?}

"that's our water disch permit is
up the chimney"

added closed loop seal water pumps (renew H₂O to system).

of 2nd eff condenser - used cooled dist. off TSC through
heat exchangers. → used as
cooling water in condenser
not adding extra H₂O. - helped H₂O balance

⊕ experience counts

Eng, Equip Mng. Operations → lesson learned

Jim Beninati, HDR Eng. - Reviewer

15 yrs exper
Bo - (orn.
MS. - ?

background - more incentives for ZLD
tech & sch. challenges.

pre existing plus/chem system w/ Hg control.
eliminate need for NPDES permit.

Comments:

system efficiencies - quantitative data?

crystallizer blowdown - fly ash wetting agent.

← go that way or full ZLD?
+ Challenges? (corrosive, solids, etc.)

what about more water than fly ash?

ZLD high temp / high salinity - corrosion.

materials of construction? testing?
how arrived?

site constraints - ✓

redise effluent. - ened. distillate - contract given 200 mm

max or min - corrosion?

Salt quality? mixed or single salt system.
gram. size etc. -

Trish inches every side of build.
4 chem feed
1st eff flash tank
2nd
dumpster - filter press

Materials of Construction:

Jatan & Springfield & Duke?
4th time at this - experience
+ alot of time on materials research
tried alternative materials & cost reduction
worked wonderfully - 6 did get savings.
on materials.

crystallizer blowdown →
why to fly ash

match our ZLD conc. brine to mix w/ fly ash

match - why need crystallizer

Rich

Not alot of mixing w/ brine + fly ash
getting chem right - drive to ZLD.

Salt cake quantity → solubility

describe make CaSO₄

phys/chem - metals drop out - does well.

New, Nell → good quality ↓ low metals

that's what phys/chem - ppt levels ←

14 ppt Hg.

"all in solid phase"

little ending up because metals so low.

majority metals in solids from phys/chem

med
landfills.

ret all contract guarant. - dist. quality - no problems
haven't noticed anything cycling up.

B4V? crystallizer purge stream?

ans: during some upset conditions
diff things - back to phy/chem or to
absorber or fly ash
mixing.
& off-site.

All metals out w/ phy/chem
process improvements in series
Hg - good oper. practice for MS,
removal.
continue to run all the time.

Hygroscopic salts?

CaCl₂ - problem
bet. we creating NaCl (soften).
& going to a commercial lined landf