



21st Annual – Produced Water Seminar

HDPE Lined Produced Water Evaporation Ponds

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WEAVER

BOOS

CONSULTANTS

HDPE Lined Produced Water Evaporation Ponds



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TOPIC OF PRESENTATION:

Use of High Density Polyethylene (HDPE) as the top layer of brine (production) water evaporation pond facilities.



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High Density Polyethylene (HDPE) was used as the primary or top layer of the lined ponds in order to protect the groundwater and to enhance the evaporation of the production water within the ponds.



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Projects located in semi-arid regions of eastern Utah (Danish Flats) near Cisco and north of Baggs, WY (Southern Cross) that are ideally situated for evaporation.



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INTRODUCTION:

- Production water delivered to the sites via tanker trucks for disposal by evaporation.
- Danish Flats facility went operational with 4 ponds in May 2008, and currently at 13 ponds operational as of June 2009.
- Southern Cross facility went operational with 2 ponds in July 2008 with an additional pond constructed in 2010.



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INTRODUCTION (continued):

- Each constructed evaporation pond is approximately 5.2 acres at the top of the berm (Utah=65 acres of ponds, WY=15 acres of ponds).
- The evaporation ponds hold approximately 330,000 barrels (42 gallon/barrel) of production water at 12 feet depth at capacity or approx. 580,000 barrels at 22 feet deep.
- Production water (brine water) is delivered by truck and moved from an off-loading area to the ponds mostly by gravity.
- Sludges and byproducts are removed through various pretreatment processes. At Danish Flats, emissions from pretreatment are routed to a control device.



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PROCESS:

- Truck receiving area/off-loading via hose and pipeline to initial phase separation in acceptance pits or gun-barrel tanks at Southern Cross.



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PROCESS:

At Danish Flats, off-gases from acceptance pits and gun barrel tanks are routed to a control device, which includes a thermal oxidizer and scrubber.



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PROCESS:

- From acceptance pits/tanks the water moves by gravity to the HDPE lined and bird-net covered settlement/sludge pond for last stage of sludge removal and collection at Southern Cross.



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PROCESS:

- At Southern Cross, the “brine” water is fed by gravity pipe to the evaporation ponds from the settlement/sludge pond.



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PURPOSE:

- Dispose of production water generated from oil and gas development in Utah, Colorado, and Wyoming.
- Several million barrels of production water is generated each year in the mountain states.
- Other types of evaporation and disposal facilities exist.



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SELECTION OF TECHNOLOGY:

- Technologies for disposal of production water:
 - Injection back into the ground
 - “Frac” injection of the water back down into the formation to enhance production
 - Treatment for surface discharge
 - Evaporation



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EVAPORATION:

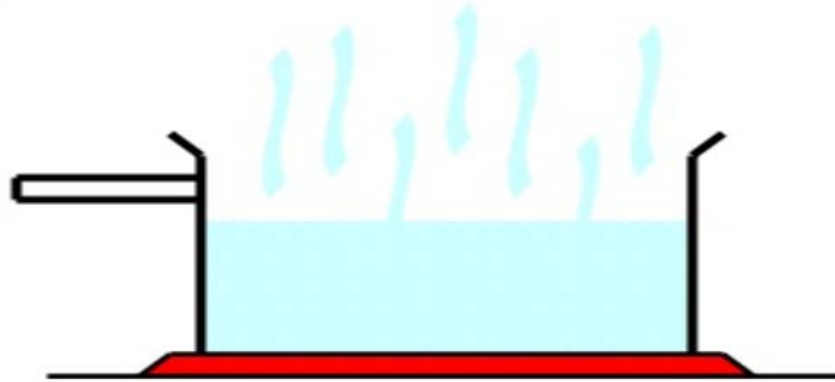
- Ponds designed to store and evaporate production water.
- Top layer of the pond liner is textured surface 60-mil HDPE.
- Climate ideal in the semi-arid mountain west for evaporation during May through October.
- HDPE liner aided evaporation due to black color of surface.



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EVAPORATION (continued):

- Design evaporation rate estimated to be approximately 50 inches of water annually at Danish Flats, and 40 inches at Southern Cross.



- Actual evaporation encountered during 2008 was nearly 70 inches (due to shallower water in ponds) and in 2009 was nearly 60 inches at Danish Flats; and approx. 55 inches at Southern Cross. Deeper ponds (22 ft.) experienced approx. 30% lower evaporation than the shallower (12 ft.) ponds.



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DESIGN...WHY HDPE?:

Textured 60-mil HDPE for top liner of ponds not buried.

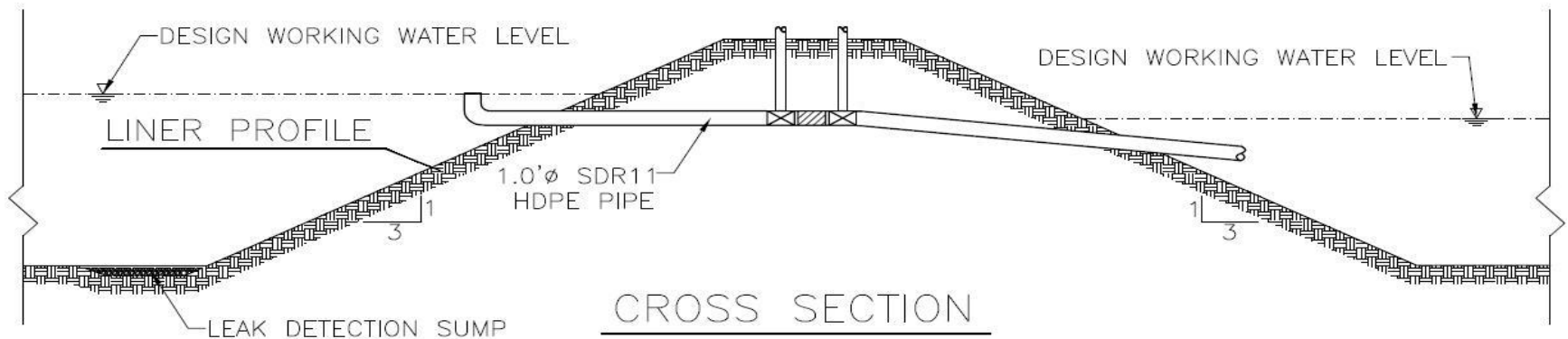
- Ultraviolet (UV) degradation resistance.
- Durability (20 plus years, *Ivy 2002*).
- Chemical resistance.
- Black color enhances evaporation of water.
- HDPE was chosen over clay liner and other geomembranes due to being the most compatible with site conditions and regulations (i.e. exposed to sunlight, desiccation, and hydrocarbons).
- Textured surface used to aid with traction if operations personnel fall into ponds, and to increase slope friction and stability.



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Evaporation Ponds

DESIGN (continued):



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CONSTRUCTION:

- Southern Cross ponds were designed and constructed with two geomembranes and a geonet leak layer in between.
- HDPE for primary liner was 60-mil thick for both facilities.



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OPERATIONS:

- During ideal conditions for evaporation (May through October) of water which has been found to be up to 1-inch (approx) per day on the hottest days in July in August.
- During low evaporative months of November through April, the facilities store the water in the ponds.



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OPERATIONS:

- Ideal conditions for evaporation occurs when the air temperature is above 80 degrees Fahrenheit, the wind blows, and the level of water in a pond is not greater than 3 feet deep.



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MAINTENANCE:

- After several years of operation (possibly 8 to 10 years), the “salt” from the production or brine water builds up as precipitate in the pond bottoms.
- Upon excessive build-up of sediments or upon closure, then all the water is evaporated and the sediments dried and either removed or the facility buried (closure).



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CONCLUSIONS:

- Facilities are serving a need of the region and the oil/gas industry.
- Evaporation of production water is one of the low cost methods for disposal.
- HDPE as the top layer is the right choice due to proven durability and resistance to UV and chemical degradation.
- HDPE improves the evaporative ability of the ponds with the black color of the liner.



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Southern Cross with two ponds operational:



Questions? Thank You!

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