

# CASE HISTORY

*An example of how GES' Carrier Gas Concentrator™ technology can provide sophisticated solutions to challenging oilfield problems*

## SUCCESS SNAPSHOT

### BENEFITS OF CGC™

- Automated system developed with proprietary algorithm that can run with limited supervision
- Low energy consumption as a result of the thermodynamic efficiency of a multi-stage bubble column design
- Highly mobile with 500 bpd or 1000 bpd units available to be run in parallel
- Low maintenance as scaling is not an issue from heat exchanger and design of system

### BACKGROUND & CHALLENGES

- Can be used to eliminate large volumes of produced water
- Can be mobilized to exploratory areas lacking infrastructure
- Meets or exceeds regulatory limits for PM emission levels

### GES SOLUTION & RESULTS

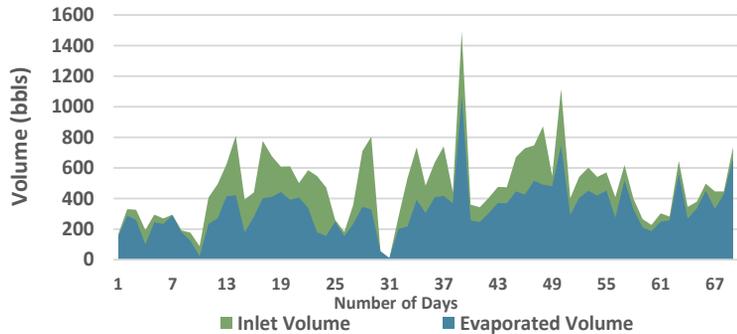
- CGC™ has greatly reduced trucking costs by reducing large volumes of produced water
- CGC™ can eliminate the need for the construction of large holding facilities
- 45% reduction in costs for disposal for the client
- Generated an additional revenue stream and a useable product for the client by generating a consistent 10# brine

**AN OPERATOR IN THE MARCELLUS WAS FACED WITH HIGH DISPOSAL COSTS** and needed an innovative solution to provide economic relief. With more than 500 wells on production, producing an average of 1-2 bbls per day for older wells, and as high as 2,000 bbls per day for new wells, the client needed a scalable solution to dispose of its produced water. Gradiant Energy Services (GES) provided that solution with its Carrier Gas Concentrator (CGC™) technology. The client was able to utilize the CGC™ technology to reduce disposal volumes, while positively impacting the bottom line.

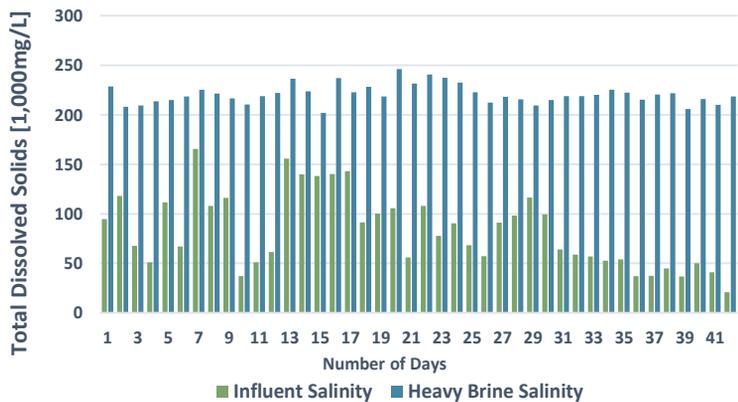
### THE CHALLENGE

In many areas a solution to disposal is recycling, however in the Marcellus, there is often a reduced completion schedule that in turn restricts large volumes of recycling. In addition Pennsylvania has only a limited number of water disposal sites. Operators have considered evaporation in the past, but one of the key requirements for evaporation technology is strict regulatory permitting, specific to particulate matter (PM) emission levels. Several evaporation technologies such as submerged combustion or flash evaporation will not meet the strict PM emission requirements and also require high levels of energy. As a result, operators would truck the majority of produced water to the neighboring state of Ohio. This came at an extremely high cost of \$8-\$15 per bbl just to dispose of the produced water.

### EVAPORATED VOLUME VS INFLUENT VOLUME



### TOTAL DISSOLVED SOLIDS



### THE SOLUTION

The CGC™ technology involves evaporating water and concentrating dissolved solids in the wastewater stream via a multi-stage bubble column humidifier. GES has designed its fully automated and mobile system to run efficiently and effectively with limited supervision. The units come in 500 BPD and 1,000 BPD modular systems that can be placed in parallel for additional evaporation volume. The two bi-products of the system are water vapor and concentrated heavy brine at or near saturation, which can then be reused for drilling and/or workovers. The mobile units adhere to stringent PM emissions control, and are compliant to PADEP regulations. Trailer mounted allows the system to easily be re-deployed to multiple sites within 3 days.

For this particular client, GES provided the CGC™ technology for a 70-day trial which evaporated approximately 67% of the influent total. The highly concentrated brine, approximately 33% was saturated to concentrations greater than 220,000 mg/L, which could then be used in drilling operations or disposed. The client was able to manage the water production while cutting the disposal costs by over 45%. This partnership was a success as GES was able to showcase their technology and provide a needed solution to the client.