Waste to Wealth

Case Study – Glycol Dehy “Waste Gas” to Engine Air Intake (SlipStream)

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Introduction

- Typical Compressor Station

- Typical Glycol Dehydration Unit Operation
  - Conventional Waste Gas Handling Options 1-3

- Pilot Site
  - Proposed Design
  - Objectives
  - Location/Technology Description
  - Before/After Photos

- Installation Discussion
  - Challenges

- Project Results
A glycol dehydration unit operation is often adjacent to an engine-driven compressor, but not always!
**Option 1:** Vent Waste Gas off Still Column

- **Dry Gas**
- **Wet Gas**
- **Lean Glycol**
- **Rich Glycol**

Diagram showing the flow of gases and glycols through the system:

- **High Pressure Glycol/Gas Contactor**
- **Low Pressure Glycol Regeneration System**
- **Dehy Still Column Overheads (Waste Gas)**

Components labeled:
- H2O
- Methane
- BTEX
Typical Glycol Dehydration Unit Operation – Option 2

**Option 2:**
Pipe to Tank/Condensing Tank and Vent Waste Gas

- **Dry Gas**
- **Wet Gas**
- **Lean Glycol**
- **Rich Glycol**
- **High Pressure Glycol/Gas Contactor**
- **Low Pressure Glycol Regeneration System**
- **Tank**
- **Dehy Still Column Overheads (Waste Gas)**

- **H2O**
- **BTEX**
- **Methane**

$$\text{Dehy Still Column Overheads (Waste Gas)}$$
Typical Glycol Dehydration Unit Operation – Option 3

Option 3: Pipe to Tank/Condensing Tank and Incinerate/Flare Waste Gas

CO2    H2O    Heat

Fuel Gas to Incinerator $$

Dry Gas

Wet Gas

High Pressure Glycol/Gas Contactor

Lean Glycol

Rich Glycol

Tank

Dehy Still Column Overheads (Waste Gas)

Low Pressure Glycol Regeneration System

CO2

H2O

Heat

CO2

H2O

Heat

Fuel Gas to Incinerator $$

Dry Gas

Wet Gas

High Pressure Glycol/Gas Contactor

Lean Glycol

Rich Glycol

Tank

Dehy Still Column Overheads (Waste Gas)

Low Pressure Glycol Regeneration System

CO2

H2O

Heat

Fuel Gas to Incinerator $$

Dry Gas

Wet Gas

High Pressure Glycol/Gas Contactor

Lean Glycol

Rich Glycol

Tank

Dehy Still Column Overheads (Waste Gas)

Low Pressure Glycol Regeneration System
Opportunity...

What if you operate a facility which has BOTH TEG dehydration and a Reciprocating Engine(s)?

Why not use the dehy waste gas instead of venting/burning it?
Pilot Site - Proposed Design (Dehy waste gas to engine)

CO₂, H₂O, Heat

Compressor

Fuel Gas

Engine

Air

Dehy Waste Gas

Tank

Dehy Still Column Overheads (Waste Gas)

Dry Gas

Lean Glycol

Rich Glycol

Wet Gas

High Pressure Glycol/Gas Contactor

Low Pressure Glycol Regeneration System
## Objectives

### Site GHG emission reductions (CO2 credits)
- Engine FG consumption reduction – additional sales
  (engine RemVue AFRC upgrade with dehy waste gas SlipStream)
- Dehy condensing tank vent reduction/elimination (VOC’s)

### Site Benzene emission reductions (currently venting)
- Internal combustion engine BTEX destruction (vs. flaring or incinerating)
- Regulatory compliance (now & future)
- Worker exposure reduction
- Site odor improvements

### Remote Field Dehydration Unit Operation/Optimization
- As all dehy waste gas is being conserved/utilized, dehy optimization not as significant

### CCEMC project
- ~50% subsidization (RemVue AFRC & SlipStream)

### Project aligns with CPC’s SPIRIT Values & corporate sustainability/GHG emission reduction initiatives
Pilot Location Description

- Sweet Location (0% H2S)
- Compressor Package (remote field gas gathering/compression)
  - Engine: Cat G3516LE (809kW, 1085HP)
  - Engine is currently loaded to ~95-100%
  - Control System: RemVue 500AS AFRC w/ SS50 SlipStream Add-on
- TEG Glycol Dehydration Skid
  - Dehydrates ~200 E3m3/d of raw natural gas
  - Operates with a Kimray 21015 glycol energy exchange pump
  - Operates without a flash tank
  - Operates in conjunction with a BTEX condensing tank
  - Currently regulated to 3 tonnes/yr of Benzene emitted
    - Stricter Benzene regulations coming (Jan 1 2017: 2 tonnes/yr, Jan 1 2018: 1 tonne/yr)

Technology Description

- RemVue AFRC & SlipStream – REM Technology Inc.
- SlipStream is an “add-on” of the RemVue AFRC technology
- Allows for the safe utilization of site low-pressure gas vs. venting/combusting
  - Compressor Packing/Crankcase Vents, Dehy Still Column Overheads (waste gas), Dehy Flash Tank, Atmospheric Tanks, Instrument Vents
- Can safely displace up to ~50% of the engine’s normal FG consumption
- Engine can safely/efficiently destroy & disperse site Benzene emissions
Pilot Site - Before

Dehy waste gas venting from Condensing Tank
Pilot Site - After

Dehy Waste Gas
Collected/Piped to Engine Air Intake

Dehy Waste Gas
(off condensing tank)
Pilot Site - After

- Dehy Waste Gas (from Dehy)

SlipStream Valve Train (Monitors/Controls/Isolates/Measures/Filters)

- Liquid Knock-out w/ High Level Switch
Pilot Site - After

Air → Dehy Waste Gas
SlipStream: 15.04 kg/hr, ~0.42 E3m3/d (waste gas from dehy)
Engine FG: 143.9 kg/hr, ~4.0 E3m3/d (site FG – sales pipeline)

**Approx. 10% of engine FG is currently dehy waste gas!**
Pilot Site – After (In Operation)

From Cat G3516LE Spec Sheets: (at 100% load)
- Engine rating: 1085 bHP
- Exhaust THC: 3.2 g/bHP-hr (677ppm) **>98% Benzene Destruction
- Exhaust Stack Temp: 1150 degF (621 degC) **AER D60 incinerator minimum exit temperature requirement >600 degC

Improved emission plume dispersion expected
- Exhaust stack flow rate: 5977 ft³/min
- Stack temperature: 621 degC
- Stack height: > 1.2 x building peak height
Installation Discussion

**Challenges**

- Obtaining field “buy-in” (many initial concerns)
  - Unconventional thinking to introduce “waste gas” into an engine
  - Solids/liquids carrying through into the engine
  - Engine internal corrosion concerns (water-saturated BTEX stream)
  - High heating value (engine detonation concerns)
  - Plugging of engine flame arrestor screens (intake system)
  - LEL concerns in air intake
  - Introducing gas pre-turbo
  - Unit downtime/reliability
  - No one wants to be the Guinea Pig! (1st within COP)

- Stakeholder engagement
  - Operations, M&R, Inspector, mechanical & I/E crews
  - Scheduling (MOC, materials, labor)
  - Awareness/Training
Success! We think...

- **Staged Commissioning/Start-up Approach**
  - Sept 28\textsuperscript{th}, 2013 – Commissioned/Started-up the package with a RemVue 500AS w/ SS50 control system
  - Oct 15\textsuperscript{th}, 2013 – Commissioned/started-up the dehy waste gas SlipStream
  - Ongoing site training/monitoring
    - Detailed engine inspection to be conducted at the next scheduled service

- Currently displacing >10% of the engine’s normal FG
  - **Engine currently running on \~15 \text{kg/hr, 0.42 E3m3/d of dehy waste gas**
  - \~2675 tonnes CO2e/yr GHG reduction

- **>98% Dehy BTEX destruction** in the adjacent internal combustion engine
  - Improved emission plume dispersion (engine exhaust stack vs. conventional)

- Site odor has significantly improved
- Worker BTEX exposure has been significantly reduced
- Operations has stated that the engine is starting/running great

Appears to be another viable dehy waste gas handling option...

Stay tooned!