Site Closure and Redevelopment of MGP Sites in Iowa

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Charlottesville, VA
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Alliant Energy

• Merge of:
  - IES Industries
  - Interstate Power Co.
  - Wisconsin Power & Light Co.

• Corporate offices located in:
  - Cedar Rapids and Dubuque, IA
  - Madison, WI
Alliant Energy

- Energy Services in:
  - Iowa, Wisconsin, Minnesota, Illinois
  - China, Brazil, New Zealand
- Number of employees-8,940
- Number of electric customers-956,690
- Number of gas customers-404,976
- Generation
  - 31 power plants
  - 5,200 MW output
Manufactured Gas Plants

- History and Overview
- Remediation
- Closure and Beneficial Reuse
Alliant Energy MGP Sites

- 57 MGP sites in 6 states
- 34 sites in Iowa
- 22 soil remedial actions to date
Alliant Energy MGP Sites
Manufactured Gas

- Substantial US industry from 1816 to 1960
- Called gas plants, gasworks, or town gas plants
- Combustible gas for heating, cooking, and lighting
- Produced gas from coal and petroleum
- “Baked” coal to the point where gases were emitted
Manufactured Gas

- Collected gas in large tanks/holders after processing
- Piped gas to residents and businesses for lights, stoves, water heaters and other uses
- As gas cooled, coal tar liquids condensed from gas stream into:
  - Storage structures such as tar well
  - Gas piping
  - Gas holder
Manufactured Gas

• Manufactured gas was an important phase of industrial heritage in USA
• Important role in the industrial expansion of the United States
• Used the way natural gas is used today
• Eventually replaced by natural gas and propane
Process Overview

- Heated coal in a closed vessel (retort) to produce gas
- Cooled gas in condenser to remove water vapor and tar
- Water vapor and tar sent to tar separator
- Cleaned gas to remove ammonia, hydrogen sulfide, cyanide, and light oils
- Stored purified gas in holder on site
- Distributed gas to community
MGP Structures

- Retort
- Tar/water condenser
- Tar/water separator
- Purifier/scrubber
- Tar well/cistern
- Gas holder
Manufactured Gas Plant

A) Coal Chute
B) Coke Byproduct
C) Retort
D) Hydraulic Main
E) Exhauster
F) Condenser
G) Scrubber
H) Purifier
I) Station Meter

Storage and Distribution

Gas Storage Tank

Governor

Residential Consumer

A) Gas Lamp
B) Water Heater
C) Gas Range
D) Gas Heater

Street Main
Service Line

Curb Cook

Meter

Heritage: after Smithsonian Institution (1923).
Gas Retort Benches
Knoxville, IA, circa 1918
MGP Byproducts

- Dictated by manufacturing process
- Tars and oils
- Spent oxides from hydrogen sulfide removal
- Ash, clinker, and coke
MGP Byproducts

• Sold for other uses:
  – Feedstock for chemical industry
  – Sealers
  – Dandruff shampoo
• Disposed of as waste material on or off site
• Negative effects of coal tar and other byproducts were unknown
Potential Environmental Impact

- Condensed tar during gas storage
  - Gas holder
- Byproducts generated during processing
  - Purifier
  - Tar separator
- Byproduct disposal in onsite structures
  - Tar well/cistern
- Spills during operation
Potential Environmental Impact

- Buried byproducts present environmental concerns
- Buried byproducts present health concerns
  - Dermal contact with impacted soil
  - Drinking impacted ground water
MGP Byproduct Chemistry

• Polynuclear aromatic hydrocarbons (PAHs)
  – Formed during the incomplete combustion of coal
  – Common in petroleum-derived products such as tar, asphalt, coal tar pitch

• Volatile aromatic compounds
  – Contained in light crude oils that were components of generated tar
MGP Byproduct Chemistry

- Cyanide and Ammonia
  - In spent oxides formed by passing gas over iron filings and wood chips to remove hydrogen sulfide
- Phenols
  - In coal tar acids formed during cooling of gas
  - Coal carbonization process only
- Trace metals
  - In gas plant ash and spent oxides
MGP Sites

• Estimated 1,000 to 1,500 in US per EPA
• Estimated 25,000-50,000 in US per other sources
• Over 500 in Midwest (circa 1909)
• Alliant Energy responsible for over 40 sites in 6 states
Manufactured Gas Plants

Remediation
Tar/Oil Holder
Water Well ?
Tar Cistern - South
Remedial Action

Tar Separator
Contents of Relief Holder
Remedial Action

Main Gas Holder

Valve Box

Regulator Building

Foundation
Valve Box
Piping
Main Gas Holder - Empty
Manufactured Gas Plants

Closure and Beneficial Reuse
Closure

- Remove source structures/material
- Remediate soil to allow for future use
  - Environmentally acceptable endpoints
- Establish use restrictions as necessary
  - Address residual contamination
- Conduct groundwater monitoring
  - Concurrent with beneficial use
Soil Cleanup Criteria

• Soil 0-6 feet
  - 500 mg/kg total PAHs
  - 100 mg/kg total Group B2 PAHs
  - 100 mg/kg TPH

• Soil below 6 feet
  - 3,000 mg/kg total PAHs
  - 200 mg/kg total Group B2 PAHs
  - 3,800 mg/kg TPH
PAHs

- Acenaphthene
- Acenaphthylene
- Anthracene
- Benzo(a)anthracene*
- Benzo(a)pyrene*
- Benzo(b)fluoranthene*
- Benzo(g,h,i)perylene
- Benzo(k)fluoranthene*
- Chrysene*
- Dibenzo(a,h)anthracene*
- Fluoranthene
- Fluorene
- Indeno(1,2,3-cd)pyrene*
- Naphthalene
- Phenanthrene
- Pyrene

*Group B2 PAHs (carcinogenic)
Ground Water Compliance Standards

• Non-protected ground water

• Protected ground water
  – Water bearing unit
    • Hydraulic conductivity > $5.1 \times 10^{-4}$ cm/sec
    • TDS < 2,500 mg/L

• 8 sampling events
  – Steady or declining plume
  – Natural attenuation
  – Concentration less than compliance standards
  – Source removal completed
## Ground Water Compliance Standards

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<th>Chemical</th>
<th>Protected</th>
<th>Non-Protected</th>
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<tr>
<td>Benzene</td>
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<td>Benzo(k)fluoranthene</td>
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<td>Chrysene</td>
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Beneficial Reuse

- Commercial/industrial developments
- Substations
- Pole storage yards
- Green spaces
Fairfield MGP Site
Storm Lake MGP Site
Grinnell MGP Site
Iowa Falls MGP Site
Muscatine MGP Site
Atlantic MGP Site
Charlottesville MGP

• Located at 4th and Williams Streets NW
• Operated prior to 1887 to 1951
• 1922 statistics
  – 1,600 customers
  – Population of 10, 688
  – Cost of gas was $1.50 per cubic foot
• Gas holder and relief gas holder
Charlottesville MGP-1902

Charlottesville City Gas Works.


59

Holder.
Charlottesville MGP-1920

CITY OF CHARLOTTESVILLE GAS WORKS
RUN DAY & NIGHT- NO FIRE APPR.