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IMPROVING PRODUCED WATER QUALITY FOR COAL BED METHANE

FINAL REPORT

(June – September 2004)

Prepared by:

AGV Technologies, Inc.
612 Lighthouse Avenue
Suite 273
Pacific Grove, CA 93950

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RPSEA Project Manager
Robert W. Siegfried
Vice-President, Unconventional Gas Technology

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Current high costs associated with water recovery from CBM produced water limits the reuse of this massive resource. Only a limited amount of produced water is of adequate quality to be reused; the majority of produced water is disposed of, with potential environmental impact and loss of the resource. This work summarizes the operational and cost performance for current produced water handling and treatment systems and compares the performance of the new WFRD technology for produced water recovery. The WFRD produces the highest quality recovered water from even the most contaminated produced water; meeting all reuse criteria, including potable requirements. This is accomplished with the lowest estimated processing cost per barrel, even less than the average current cost for produced water disposal. Results of this project have significant implications for the CBM gas industry, for water resource considerations, and for the Nation. A new produced water recovery technology has been identified that is appropriate for use in CBM production, recovers high quality water for reuse from highly contaminated water, and can recover 90% of the water stream while reducing the cost to less than that currently spent on produced water handling and disposal.

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RESEARCH SUMMARY

Title	Improving Produced Water Quality for Coal Bed Methane
Contractor(s)	AGV Technologies, Incorporated
GRI Contract Number	8693
Principal Contact	Robert Smith, President, AGV Technologies
Report Type	Final Report
Report Period	June 2004 – September 2004
Objective	Characterize the effectiveness of the Wiped Film Rotating Disk (WFRD) system in the recovery of water from Coal Bed Methane (CBM) produced water for reuse.
Technical Perspective	Current high costs associated with water recovery from CBM produced water limits the reuse of this massive resource. Only a limited amount of produced water is of adequate quality to be reused; the majority of produced water is disposed of, with potential environmental impact and loss of the resource.
Technical Approach	This work summarizes the operational and cost performance for current produced water handling and treatment systems and compares the performance of the new WFRD technology for produced water recovery.
Results	The WFRD produces the highest quality recovered water from even the most contaminated produced water; meeting all reuse criteria, including potable requirements. This is accomplished with the lowest estimated processing cost per barrel, even less than the average current cost for produced water disposal.
Project Implications	Results of this project have significant implications for the CBM gas industry, for water resource considerations, and for the Nation. A new produced water recovery technology has been identified that is appropriate for use in CBM production, recovers high quality water for reuse from highly contaminated water, can recover 90% of the water stream, and can accomplish this while dramatically reducing the cost currently spent on produced water

handling and disposal. The effectiveness of recovery and the associated economics potentially enable dramatic expansion of economic access to our nation's CBM reserves while protecting the environment and preserving produced water as a resource for future use. Integration of this system into CBM operations can help realize the RPSEA goal of improving economics for expanded utilization of unconventional gas reserves.

1.0 Summary

This report provides an evaluation of the current state-of-the-art in Coal Bed Methane (CBM) field production water treatment and recycling and identifies a new system with the potential to significantly decrease treatment cost and enhance water recovery. The specific question addressed is: can a CBM water treatment system recycle water for irrigation, industrial and potable uses at a cost equal to or less than the current cost of disposal? Given the quality of recovered water from such a system, surface discharge would be an option if appropriate reuse options were not available.

This analysis considers the entire water treatment system necessary to recover water of appropriate quality. This approach requires consideration of pretreatment required to condition produced water to be acceptable to a core treatment technology, performance of the core technology, brine disposal and post-treatment requirements to make the water ready for the end user. The impact of varying levels of produced water contamination are given special consideration in light of the wide range of CBM produced water qualities exhibited around the U.S. and the World.

This report is a synthesis of published references, including conference papers and proceedings, technical reports, journal articles, contract reports, reviews, feasibility analysis, and annual reports. From these, the state of technical performance and economic factors were determined. To the degree possible, given reported information, the analysis considers capital, operation and labor costs for end-to-end system treatment while allocating those costs to pretreatment, core technology and post-treatment components. The full comparison of costs among all systems is provided on the basis of cost of treatment per barrel of produced water. The result of this analysis is the identification of the most probable best solution to reduce treatment costs and enhance produced water recovery.

This study confirmed the concept and demonstrated the performance of an innovative distillation-based, water treatment system. The majority of currently produced water is disposed of via surface discharge or injection wells with associated disposal costs becoming a significant component to the economics of CBM gas production. The technology introduced here was used to process CBM production water and recover purified water appropriate for many economically valuable uses. We estimate that this water recovery can achieved at a fraction of current treatment costs in the field; even less than standard disposal costs in many areas. Several options for implementation of the technology in CBM operations were considered, including cogeneration and solar and wind-powered options, all of which could further reduce the cost of water recovery.

2.0 Introduction

Coal Bed Methane (CBM) production accounts for approximately 7.5 % of the total natural gas production of the United States and is expected to increase significantly (Nelson 1999). Increasing estimates of the size of the reserves, rising prices for natural gas, and advances in production technologies are fueling increased production. Estimates of recoverable CBM reserves have increased from about 90 trillion cubic feet (TCF) in 1990 to over 141 TCF in 2000 (USGS, 2000).

One of the major costs associated with CBM production is the handling and disposal of produced water. The ratio of water to gas varies widely among production areas, but generally ranges from less than 1 to 3 bbl MCF^{-1} (USGS, 2000). The water produced from CBM wells can vary in quality from almost potable to very contaminated, with total dissolved solids (TDS) levels as high as 180,000 ppm (ALL, 2003). The majority of CBM produced water falls in the range of 2,500 to 25,000 ppm TDS with an approximate average of 10,000 ppm. Typically CBM produced water is contaminated with sodium, barium, bicarbonates, and iron. The concentration will vary based on coal seam depth, metabolism process, aquifer recharge, and other geological conditions (ALL, 2003).

CBM produced water is typically disposed through injection into subsurface aquifers, surface discharge, or surface ponds. Concern over environmental impact of disposal and potential loss of this water resource has prompted attempts to recover the water for some beneficial purpose. Occasionally, CBM produced water is reused for beneficial purposes such as irrigation and live stock watering. Water designated for reuse must meet requirements under several Federal and State regulations, including the Clean Water Act, the Safe Drinking Water Act, and the Resource Conservation and Recovery Act. Current opportunities for reuse of produced water are dependent on the quality, which varies widely, but often the high salinity precludes its use.

The economic impact of produced water management on CBM production has resulted in the focus of significant resources around the World on developing approaches to reduce the cost of disposal of this material. This report characterizes the current practices and technologies employed in management of CBM produced water and supplies test results for an innovative water treatment system for recovery of CBM production water. This new technology significantly reduces the cost of produced water treatment through high-energy efficiency and reduced pre-treatment requirements.