Evaluation of High-Efficiency Gas-Liquid Contactors for Natural Gas Processing

**Semi-Annual Report
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Office of Fossil Energy
Morgantown Energy Technology Center
Morgantown, West Virginia

By
Institute of Gas Technology
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MASTER

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Technical Progress Report (3rd Semi-Annual)
Cooperative Agreement No. DE-FC21-92MC28178
Reporting Period: 10/01/93 - 03/31/94

PROJECT OBJECTIVE

The objective of this proposed program is to evaluate the potential of rotating gas-liquid contactors for natural gas processing by expanding the currently available database. This expansion will focus on application of this technology to environments representative of those typically encountered in natural gas processing plants. Operational and reliability concerns will be addressed while generating pertinent engineering data relating to the mass-transfer process.

WORK TO BE PERFORMED THIS REPORTING PERIOD

- ◆ Complete all negotiations and processing of agreements.
- ◆ Complete assembly, modifications, shakedown, and conduct fluid dynamic studies using the plastic rotary contactor unit.
- ◆ Confirmation of project test matrix.
- ◆ Finalize dehydration and gas sweetening program strategies.
- ◆ Locate, and transport an amine plant and dehydration plant.

WORK ACCOMPLISHED THIS REPORTING PERIOD

Task 1. National Environmental Policy Act

This task was completed.

Task 2. Field Experimental Site Selection

This task was inactive.

Task 3. Field Experimental Skid Unit Design And Preliminary Economic Evaluations

This task was inactive.

Task 4. Project Review

This task was inactive.

Task 5. Information Required for NEPA, Field Site

This task was inactive.

Task 6. Fluid Dynamic Studies

The blower and variable frequency drive for the low pressure rotary contactor unit were received from vendors in November and December of 1993 respectively. Both were installed and assembly of the low pressure unit was completed except for connection of the computerized data collection system. IGT is still awaiting Paul Platko and GRI's data acquisition system from Glitsch. In the mean time shake down of the unit was performed.

A calibration test matrix was developed for review by GRI, DOE, and Glitsch. These runs were duplicates of previously conducted experiments used to verify proper operation of this rotating contactor unit. Pressure drop was measured as a function of contactor rpm, and gas and liquid flow rates. Most of the data collected is presented in the Appendix A of this report.

Some additional calibration testing of the plastic rotary contactor unit was conducted and the data is being analyzed. Also, preparation of the apparatus for connection of the computerized data collection system was initiated. A letter from Mr. Howard Meyer of GRI was sent to Mr. Spalding of Glitsch requesting that the computer and remaining GRI property relating to this project be sent to IGT. Glitsch is in the process of sending the previously mentioned items.

Task 7. Mass-Transfer Coefficient Studies

The packet of plant options previously developed and reported on in the Technical Progress Report (2nd Semi-Annual) were distributed to both GRI and DOE for review and discussion. IGT is in the process of contacting designers and manufacturers of rotating equipment to enlist their expertise in analyzing the mechanical aspects of the rotating contactors.

Appendix B contains a list of designers and manufacturers of rotating equipment IGT has compiled and a copy of the background information being distributed to them. IGT is seeking experts to analyze the mechanical aspects of the rotating contactor design for effectiveness and production cost. Feedback and additions to this list is sought from all concerned parties (i.e. GRI Advisors, GRI, DOE, Glitsch,...). In response to our request for feedback on designers/experts and manufacturers of rotating equipment, DOE has recommended IGT talk to:

Mr. Kymus Ginwala and Mr. Willem Jansen
Northern Research & Engineering Corp.
39 Olympia Ave.
Woburn, Mass. 01801-2073

Comparison of quotes for the 0.5 and 1.0 million SCFD dehydration units is underway. Prices range from \$14,000 to \$39,000 for these units with up to 8 weeks delivery time. The most effective regeneration system for these systems is designed to achieve 99.7% purity for the clean glycol fed to the main contactor.

Task 8. Field Experimental Studies

This task was inactive.

Task 9. Data Analysis and Reports

A paper and presentation was given by Mr. Tony Lee at DOE's Fuels Technology Contractors Review Meeting, November 16-18, 1993. On January 27th, 1994, Jim Semrau made a presentation to IGT's Sustaining Membership Program Technical Guidance Committee. A poster presentation will be made on this project to IGT's Sustaining Membership Program on April 28th by Jim Semrau.

The following action items are still pending:

Glitsch is to provide IGT:

- ◆ Royalty-free use of Higee^{TM} Technology.
- ◆ No cost loan of the "China Unit".
- ◆ Piping diagram of the China Unit.
- ◆ Completed agreement for involvement of Mr. Platko, Mr. Fowler, and Mr. Spalding.

WORK TO BE PERFORMED NEXT PERIOD

- ◆ Connection of computer data acquisition system to low pressure rotary contactor system.
- ◆ Initiation of the experimental program for Task 6. Fluid Dynamic Studies.
- ◆ Continue processing of subcontracts with Glitsch.
- ◆ Review of test matrix.

Tony

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Reference to trade names or specific commercial products, commodities, or services in this report does not represent or constitute an endorsement, recommendation, or opinion of suitability by GRI or IGT of the specific commercial product, commodity, or service.

This is an interim report; hence, the data, conclusions, and calculations are preliminary and should not be construed as final.

APPENDIX A

Plastic Rotary Contactor Calibration Flooding Test Results

Gas Phase: Air

Liquid Phase: Water

Data Point Number	Rotor Speed rpm	Liquid Flow Liquid GPM	Gas inlet Temperature deg F	Gas inlet Pressure In. H2O	Gas inlet Flow CFM	Gas inlet Flow SCFM	Delta-P In. H2O
1	600	30	99	14.4	517	498	14.01
2	600	30	101	20.3	646	629	20
3	600	30	102	22.2	679	662	21.9
4	600	30	102	22.9	690	674	22.62
5	600	30	102	22.7	703	687	24.2
6	600	30	102	25.2	746	733	24.7
7	600	30	102	25.9	760	748	25.6
8	600	30	101	27.2	780	771	25.95
9	600	30	101	27.4	810	801	27.1
10	600	30	102	23.1	690	675	22.9
11	600	30	102	27.8	816	807	27.3
12	600	30	102	28.8	831	823	28.1
13	600	60	104	14.29	360	344	14.29
14	600	60	102	15	370	355	15.5
15	600	60	102	17.5	397	383	17.9
16	600	60	103	19.9	448	434	20.1
17	600	60	103	19.8	440	426	20
18	600	60	103	19.2	430	416	19.59
19	600	60	103	19.2	428	414	19.59
20	600	60	103	19	419	405	19.05
21	600	60	102	18.9	425	411	19.1
22	600	60	102	20.9	482	469	20.6
23	600	60	102	22.8	518	506	23.05
24	600	60	103	24.2	530	519	24.18
25	600	60	102	24.32	540	529	24.3
26	600	60	102	25	550	540	24.99
27	600	60	104	25.9	559	548	25.81
28	600	60	104	27.2	551	542	27.4
29	600	60	103	28.1	573	566	28.1
30	900	30	104	6.35	250	234	6.3
31	900	30	104	7.1	290	272	6.9
32	900	30	104	7.18	338	317	6.8
33	900	30	104	8	426	400	7.9
34	900	30	105	9.65	480	452	9.6
35	900	30	105	9.9	495	467	9.7

Data Point Number	Rotor Speed rpm	Liquid Flow Liquid GPM	Gas inlet Temperature deg F	Gas inlet Pressure In. H2O	Gas inlet Flow CFM	Gas inlet Flow SCFM	Delta-P In. H2O
36	900	30	104	9.8	515	486	10
37	900	30	104	10.2	537	508	10.41
38	900	30	103	10.8	550	521	10.79
39	900	30	103	10.7	559	530	10.8
40	900	30	104	11	572	542	11.1
41	900	30	104	11.5	611	579	11.6
42	900	30	104	12.3	639	607	12.4
43	900	30	105	12.3	667	632	12.4
44	900	30	104	13.4	715	681	13.5
45	900	30	105	14.2	780	743	14.69
46	900	30	104	15.3	823	787	15.15
47	900	30	103	16.2	833	800	16
48	900	30	103	16.6	842	809	16.4
49	900	30	104	17.7	880	847	17.59
50	900	30	104	18.4	900	867	18.1
51	900	60	104	8.2	366	344	8.6
52	900	60	105	11.19	503	476	11.41
53	900	60	105	12.22	550	521	12.5
54	900	60	106	13	602	571	13.21
55	900	60	106	14.8	675	643	14.82
56	900	60	107	15.4	712	678	15.65
57	900	60	108	16.4	762	726	16.63
58	900	60	108	17.4	805	768	17.63
59	900	60	107	17.9	783	750	18.1
60	900	60	106	19.4	829	798	19.25
61	900	60	107	19.68	832	800	19.62
62	900	60	107	21.2	888	857	21
63	900	60	107	22	905	875	21.7
64	900	60	107	22.5	931	901	22.3
65	900	90	104	9.4	425	401	9.4
66	900	90	104	10.5	450	426	10.5
67	900	90	102	11.22	488	464	11.22
68	900	90	104	12.82	548	521	12.82
69	900	90	104	14.3	596	569	14.3
70	900	90	104	15	610	583	15
71	900	90	104	15	621	594	15
72	900	90	105	16.5	664	636	16.5
73	900	90	105	17.5	704	676	17.5
74	900	90	105	18.3	740	712	18.3
75	900	90	104	19.4	715	691	19.4
76	900	90	105	20.5	761	736	20.5

Data Point Number	Rotor Speed rpm	Liquid Flow Liquid GPM	Gas inlet Temperature deg F	Gas inlet Pressure In. H2O	Gas inlet Flow CFM	Gas inlet Flow SCFM	Delta-P In. H2O
77	900	90	105	21.2	755	731	21.2
78	1200	30	105	9.00	300	282	9.40
79	1200	30	103	9.65	322	304	10.10
80	1200	30	103	10.00	347	328	10.42
81	1200	30	104	10.13	353	334	10.45
82	1200	30	104	10.40	375	355	10.70
83	1200	30	105	10.90	409	386	11.23
84	1200	30	105	10.63	454	429	11.95
85	1200	30	105	12.41	513	487	12.70
86	1200	30	106	13.25	560	531	13.40
87	1200	30	107	14.25	613	582	14.30
88	1200	30	107	14.60	652	619	14.65
89	1200	30	107	15.85	710	676	15.83
90	1200	30	107	16.00	746	711	16.20
91	1200	30	108	16.65	787	750	16.85
92	1200	30	107	17.50	776	742	17.50
93	1200	30	108	18.20	817	781	18.19
94	1200	30	108	18.20	848	811	18.19
95	1200	30	108	18.60	840	804	18.59
96	1200	30	108	19.30	897	860	19.30
97	1200	30	108	20.40	942	906	20.00
98	1200	30	108	21.00	975	939	20.50
99	1200	60	102	10.80	410	389	10.80
100	1200	60	102	11.80	450	428	11.80
101	1200	60	103	12.50	475	452	12.50
102	1200	60	100	12.75	493	472	12.75
103	1200	60	100	12.95	508	487	12.95
104	1200	60	100	13.50	546	524	13.50
105	1200	60	100	14.75	606	583	14.75
106	1200	60	100	15.00	625	602	15.00
107	1200	60	102	16.25	684	658	16.25
108	1200	60	102	17.25	736	710	17.25
109	1200	60	103	17.85	796	767	17.85
110	1200	60	103	18.75	765	739	18.75
111	1200	60	102	19.25	779	755	19.25
112	1200	60	103	20.10	828	802	20.10
113	1200	60	104	20.40	860	833	20.40
114	1200	60	104	21.50	914	887	21.50
115	1200	60	104	21.90	928	902	21.90
116	1200	60	104	22.00	929	903	22.00
117	1200	60	105	22.75	957	930	22.75

Data Point Number	Rotor Speed rpm	Liquid Flow Liquid GPM	Gas inlet Temperature deg F	Gas inlet Pressure In. H2O	Gas inlet Flow CFM	Gas inlet Flow SCFM	Delta-P In. H2O
118	1200	60	104	23.00	980	955	23.00
119	1200	60	104	24.25	1011	988	24.25
120	1200	60	104	25.25	1065	1043	25.25
121	1200	60	104	26.25	1085	1065	26.25
122	1200	90	104	11.15	369	350	11.75
123	1200	90	104	12.30	425	404	12.80
124	1200	90	103	13.40	472	450	13.75
125	1200	90	104	14.30	516	492	14.62
126	1200	90	103	14.25	519	496	14.70
127	1200	90	103	14.30	525	502	14.70
128	1200	90	104	15.00	550	526	15.30
129	1200	90	104	15.60	590	565	15.90
130	1200	90	104	17.10	656	630	17.21
131	1200	90	104	17.25	669	643	17.45
132	1200	90	104	18.80	734	708	18.78
133	1200	90	105	19.20	778	750	19.19
134	1200	90	105	20.25	765	739	20.19
135	1200	90	104	21.60	828	804	21.50
136	1200	90	104	22.25	876	852	22.00
137	1200	90	104	23.25	898	875	22.81
138	1200	90	104	23.75	922	900	23.39
139	1200	90	104	24.00	934	912	23.59
140	1200	90	104	25.00	964	943	24.43
141	1200	90	104	25.25	975	955	24.65
142	1200	90	105	26.00	992	971	25.45
143	1200	90	105	26.60	1022	1002	25.90
144	1200	90	105	27.20	1040	1021	26.40
145	1200	90	105	27.75	1054	1036	26.99
146	1200	90	105	28.10	1077	1060	27.25

APPENDIX B

EXPERTS IN ROTATING EQUIPMENT

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