

Wastewater Treatment Unit Program Evaluation Report



Quanics
Aerocell Model ATS-SCAT-8-AC-C500
UV Light Disinfection for Fecal Coliform Reduction

NSF International
789 N. Dixboro Rd.
Ann Arbor, MI 48105

**Analysis of Fecal Coliform Reduction
Quanics Model Aerocell ATS-SCAT-8-AC-C500
with UV Disinfection**

Work completed under Contract No. 05/01/2015/060

June 2008

EXECUTIVE SUMMARY

Testing of the Quanics Aerocell Model ATS-SCAT-8-AC-C500 treatment system with UV Disinfection was conducted under the provisions of NSF/ANSI Standard 40 for Residential Wastewater Treatment Systems (August 2005 Revision), which was developed by the NSF Joint Committee on Wastewater Technology. Quanics requested that sampling be completed to determine performance of the Salcor UV Disinfection system, with their model ATS-SCAT-8-AC-C500 for fecal coliform reduction.

The performance evaluation was conducted at the NSF Wastewater Technology Test Facility located in Waco, TX using wastewater diverted from the Waco municipal wastewater collection system, which serves predominantly residential development. Dosing to the treatment system began on May 20, 2007 and sampling for fecal coliform began on May 21, 2007. Due to a voltage discrepancy in the power being supplied to the UV unit, the unit was replaced on July 17, 2007 and on August 7, 2007 the voltage to the unit was corrected and sampling was restarted and continued through January 30, 2008. Sampling started in the summer and continued into the winter, covering a range of operating temperatures.

The Model ATS-SCAT-8-AC-C500 was dosed with raw wastewater at the design rated capacity of 500 gallons per day through the entire testing period. Wastewater was dosed to the ATS-SCAT-8-AC-C500 according to the schedule below, as listed in Standard 40:

6 a.m. to 9 a.m. - 35 percent of daily rated capacity (175 gallons)

11 a.m. to 2 p.m. - 25 percent of daily rated capacity (125 gallons)

5 p.m. to 8 p.m. - 40 percent of daily rated capacity (200 gallons)

The Quanics ATS-SCAT-8-AC-C500 system with UV disinfection performance is summarized below:

The geometric mean for the fecal coliform concentration of the UV effluent was 16 cfu/100 mL. The 30-day geometric mean of the fecal coliform concentration from the UV effluent ranged from 4 to 71 cfu/100 mL. The minimum 30-day geometric mean of the fecal coliform concentration from the influent was 2.7×10^5 cfu/100 mL while the maximum 30-day geometric mean was 5.8×10^6 cfu/100 mL. Additionally, data was taken for effluent color, turbidity, temperature, pH, and dissolved oxygen. The effluent color ranged from 5 to 45 color units. Effluent turbidity ranged from a minimum of <0.5 NTU to a maximum of 13 NTU. The effluent temperature ranged from 23°C to 25°C. The effluent pH ranged

from 6.8 to 6.9. The effluent dissolved oxygen ranged from 1.6 to 2.0 mg/L. The system effluent flow rate was measured during fecal sample collection times and ranged from 0.72 to 0.85 gallons per minute.

This report includes fecal coliform data generated during the performance evaluation along with verification of the 30-day geometric means of influent and effluent fecal coliform data. This evaluation does not indicate NSF/ANSI Standard 40 compliance, nor should this report be construed as an NSF approval of the disinfection equipment.

1.0 Introduction

The evaluation was conducted to determine the performance of the Quanics Model ATS-SCAT-8-AC-C500 with Ultraviolet disinfection for fecal coliform reduction.

Chemical analyses of samples collected during the evaluation were completed using the procedures in *Standard Methods for the Examination of Water and Wastewater* (19th Edition) and USEPA methods. This report describes the procedures and observations that occurred during the test, and includes all fecal coliform data generated between August 08, 2007 and January 30, 2008 along with verification of the 30-day influent averages of both BOD₅ and TSS.

Table 1. Summary of NSF/ANSI Standard 40 Analytical Results

	<u>Average</u>	<u>Std. Dev.</u>	<u>Minimum</u>	<u>Maximum</u>	<u>Median</u>
Biochemical Oxygen Demand (mg/L)					
<i>Influent (BOD₅)</i>	200	8	59	600	180
Total Suspended Solids (mg/L)					
<i>Influent</i>	240	15	39	1680	210
pH					
<i>Influent</i>	-	-	6.8	7.0	6.9

2.0 Process Description

The ATS-SCAT-8-AC-C500 treatment system is an attached growth packed bed reactor, which utilizes open cell foam media. In the packed bed reactor, microorganisms remove soluble contaminants from the wastewater, utilizing them as a source of energy for growth and production of new microorganisms. The organic matter is attacked by extracellular enzymes that solubilize the solids to make them available to the microorganisms as a food source. The organisms primarily responsible for the degradation of the organic and some inorganic matter are aerobic bacteria. As such, the transfer of oxygen into the wastewater is critical to the treatment process.

The ATS-SCAT-8-AC-C500 system is made up of a primary treatment tank and a secondary treatment unit. Raw sewage enters a two-compartment, 1,500 gal concrete tank. The first compartment (1,000 gal) provides primary treatment, where settleable solids accumulate on the bottom and floatable solids accumulate on the surface. A Zabel A300-8x18-VC effluent filter is provided on the pipe between the

first and second compartments of the tank to help retain solids in the first compartment. Effluent from the clear layer of the first compartment flows into the second compartment of the tank (500 gal). A pump located in a screened pump vault in the second compartment transfers effluent to the filter pod for secondary treatment.

Four spray nozzles inside the filter pod distribute the liquid over an open cell foam media (85 ft³) inside the pod. The applied wastewater percolates down through the media and is collected at the bottom of the pod. The collected water flows out through a pipe to an automated splitter valve located in a gravity recirculation device. During periods of no flow to the system, all of the treated effluent is returned to the first compartment (100% recirculation). Otherwise, approximately 20% of the treated effluent is discharged and 80% is returned to the first compartment. Aeration is provided by the sprinkling action of the water over the media and as the water moves down through the media.

The disinfection unit is rated at 120 Volts AC. The nominal length of the ultraviolet lamp is 31 inches (789mm) and provides an ultraviolet light radiant intensity of 125 microwatts at one meter. The ultraviolet light is rated at 30 watts. Specifications and drawings for the UV system are included in Appendix A. This information is based on the manufacturer's literature.

3.0 Evaluation Methods

3.1 Sampling Methods

All influent BOD₅ and TSS samples and effluent CBOD₅ and TSS samples were 24-hour composite samples during the evaluation, collected by automatic samplers programmed to sample in coordination with the charge of influent wastewater to the system. Grab samples for fecal coliform were collected three days per week, alternately during one of each of the three dosing periods defined under Section 8.2.2.1 of NSF/ANSI Standard 40 (August 2005 revision). Samples were collected at approximately the same time from the influent to the Model ATS-SCAT-8-AC-C500, the effluent from the Model ATS-SCAT-8-AC-C500 and the effluent from the UV system.

3.2 Analytical Methods

Fecal coliform samples collected during the evaluation were analyzed by an NSF subcontract lab, using Method 9222D of *Standard Methods for the Evaluation of Water and Wastewater* (20th Edition).

4.0 Evaluation Results

Dosing of the Quanics Model ATS-SCAT-8-AC-C500 with ultraviolet light disinfection at a rate of 500 gallons per day began on May 20, 2007. The influent BOD₅ and TSS 30-day average concentrations for the UV disinfection test met the requirements of Standard 40 throughout the test, with overall averages of 200 mg/L and 235 mg/L, respectively, as shown in Table 1.

The 30-day geometric means for the UV treated effluents were well below the requirement of 200 cfu/100mL for the six months of testing. The complete set of fecal coliform data, as well as data for color, turbidity, temperature, pH, DO and UV system flow rate are provided in Appendix B.

Table 2. Fecal Coliform 30-day Geometric Mean Results

Month	Fecal Coliform Geometric Mean (cfu/100 mL)		
	System Influent	System Effluent	UV Effluent
1	4.2 x 10 ⁶	231	71
2	1.8 x 10 ⁶	15	19
3	2.7 x 10 ⁵	90	38
4	4.8 x 10 ⁶	89	8
5	5.8 x 10 ⁶	9	10
6	2.4 x 10 ⁶	5	4

Standard 40 allows for data to be excluded from pass/fail evaluations due to unexplainable circumstances at the testing facility or the analytical laboratory. During the testing of the Model ATS-SCAT-8-AC-C500, there was a gradual decrease in UV unit performance from May 21, 2007 through July 16, 2007. A representative from Quanics along with an NSF staff representative evaluated the system and determined that the voltage running to the UV device was insufficient. The UV unit was replaced on July 17, 2007, the voltage to the unit was corrected on August 7, 2007 and the fecal coliform evaluations began again on August 8, 2007. The test was extended into January 2008 in order to collect a sufficient number of fecal coliform samples.

On August 17, 2007 the system effluent and UV effluent results were Too Numerous to Count (TNTC) and these numbers were not included in the overall averages. In addition, data on January 18, 2007 was

excluded from this report, as the results indicated that the samples were switched during analysis. The influent results were consistent with our effluent results and the reverse was also true.

5.0 Summary

NSF conducted an evaluation of the Quanics Model ATS-SCAT-8-AC-C500 with UV disinfection. The testing was conducted in accordance with NSF/ANSI Standard 40 protocol with dosing starting on May 20, 2007. The Quanics Model ATS-SCAT-8-AC-C500 received an influent wastewater having overall average BOD₅ and TSS concentrations within the ranges set by Standard 40. The influent fecal coliform concentrations were within the $10^5 - 10^7$ range for the entire testing period. The 30-day geometric means for the UV treated effluents ranged from 4 cfu/100 mL to 71 cfu/100 mL.

Appendix A

Plant Specifications and Drawings

Quanics
AeroCell Model ATS-SCAT-8-AC-C500

Plant Capacity

Design Flow	500 gpd
Septic Tank Hydraulic Capacity at Design Flow	1,000 gallons
Pump Tank Hydraulic Capacity at Design Flow	500 gallons
Hydraulic Retention Time (at Design Flow)	
Septic Tank	48 hours
Pump Tank	24 hours

Effluent Filter

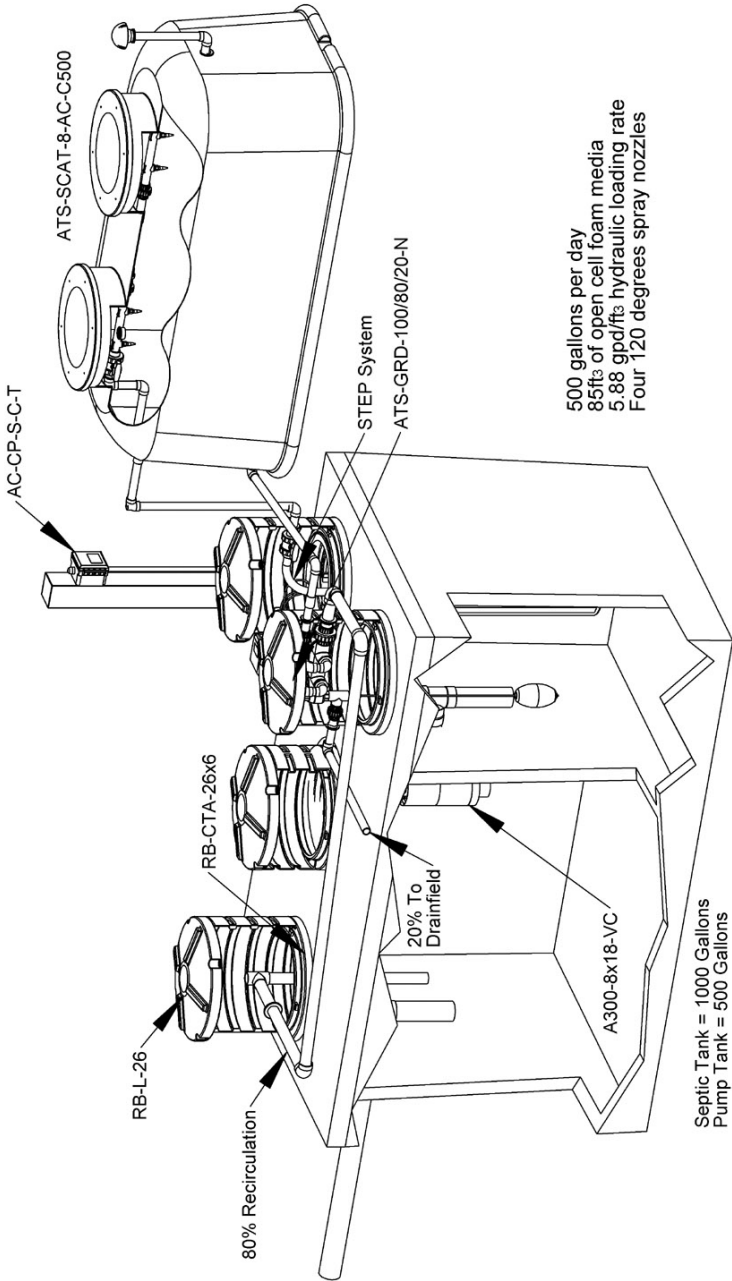
Filter	Zabel A300-8x18-VC
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Open Cell Foam Media

Size	~8 in ³ cubes
Void Space:	82%
Density:	1.45 - 1.65 lbs/ft ³
Moisture Holding:	1 ft ³ holds 0.92 ft ³ of water
Porosity/Air Flow:	3.5 – 4.5 ft ³ /min

Note: For a complete set of drawings see the Aerocell ATS-SCAT-8-AC-C500 Standard 40 Report

ZONE	REV.	REVISIONS	DATE	APPROVED



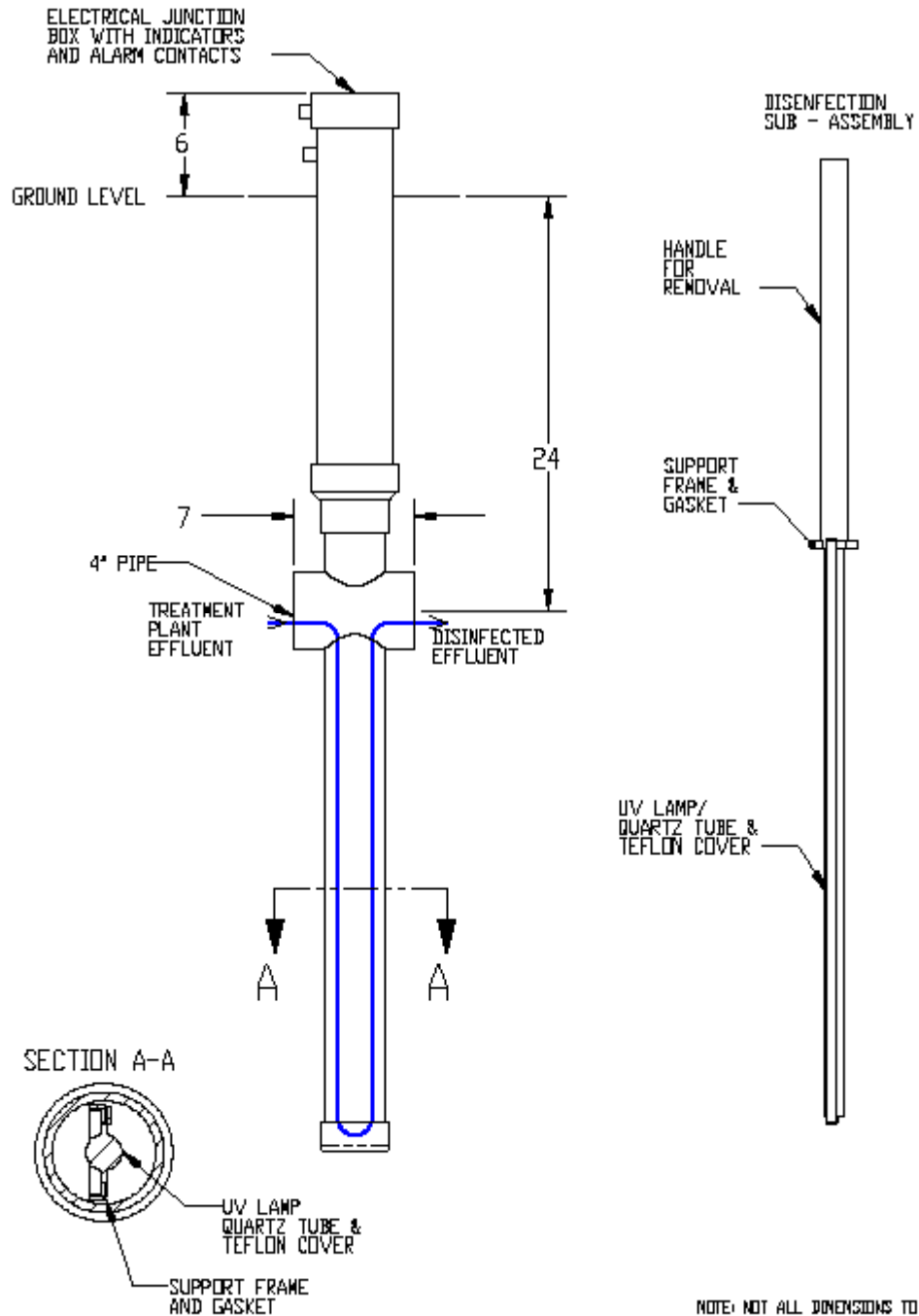
Parts Included:

- ATS-SCAT-8-AC-C500
- A300-8x18-VC
- FPV-H44-4
- P-SE-13T
- PDS-ED-1.5
- PDS-GT-1.25
- PDS-GT-1.5 (2x)
- AC-FT-3
- AC-JSB-4
- AC-CP-S-C-T
- ATS-GRD-100/80/20-N
- RB-CTA-26x6 (4x)
- RB-R-26x18 (3x)
- RB-L-26 (3x)

Product(s) covered by one or more U.S. and/or International patents. Other U.S. and International patents may be pending.

QUANICS Incorporated				DATE	08-08-05
P. O. Box 1520 Crestwood, Kentucky 40014-5154 877-782-6427 Quanics.net				NAME	TNJ
SIZE DWG. NO. A				DRAWN	CHECKED
REV. 1				ENG APPR.	BB
WEIGHT:				MFG APPR.	
SHEET 1 OF 1				Q.A.	
COMMENTS:					
DIMENSIONS ARE IN INCHES					
TOLERANCES:					
FRACTIONAL: ±					
ANGULAR: MACH ±					
BEND ±					
TWO PLACE DECIMAL ±					
THREE PLACE DECIMAL ±					
MATERIAL					
FINISH					
SCALE 1:35					
APPLICATION					
NEXT ASSY					
USED ON					

SALCOR UV DISENFECTION UNIT



Appendix B

Analytical Results

Date	Fecal Coliform (cfu/100 mL)			Color	Turbidity (NTU)	Temperature (°C)	pH	Flow Rate (g/min)	DO (mg/L)
	Raw Influent	Effluent	UV Effluent						
08/08/07	6,100,000	300	<10	30	3.25	23	6.9	0.81	1.7
08/10/07	12,200,000	<100	<20	35	3.11	23	6.9	0.78	1.6
08/13/07	7,400,000	400	<10	30	2.81	23	6.9	0.85	1.6
08/15/07	14,600,000	<100	<10	25	2.55	23	6.9	0.82	1.6
08/17/07	13,000,000	TNTC	TNTC	40	1.87	23	6.9	0.79	1.6
08/20/07	33,000	34,000	40,600	35	3.03	23	6.9	0.85	1.6
08/22/07	5,400,000	5,600	2,200	30	2.04	23	6.9	0.79	1.6
08/24/07	6,550,000	220	500	37	2.13	23	6.9	0.82	1.7
08/27/07	4,050,000	<100	<100	35	3.17	24	6.9	0.78	1.6
08/29/07	7,600,000	<20	<10	30	3	24	6.9	0.79	1.7
08/31/07	4,300,000	<20	<20	35	2.96	24	6.9	0.77	1.6
09/03/07	11,800,000	300	<100	30	2.7	24	6.9	0.77	1.6
09/05/07	740,000	40	<10	20	2.4	24	6.9	0.78	1.6
09/07/07	6,400,000	40	100	30	2.6	24	6.9	0.79	1.6
09/10/07	7,800,000	<10	<10	25	5.7	24	6.9	NS	1.6
09/17/07	1,730,000	<10	<10	15	1	24	6.8	NS	1.7
09/19/07	5,900,000	<10	<10	<5	0.7	24	6.9	NS	1.8
09/21/07	3,600,000	<10	20	15	0.8	24	6.9	NS	1.6
09/28/07	1,500	80	90	35	<0.5	24	6.9	0.79	1.7
10/01/07	3,200,000	<10	<10	25	1.0	24	6.9	0.79	1.6
10/03/07	11,400,000	10	10	30	0.7	24	6.9	0.79	1.7
10/10/07	2,800,000	<10	<10	35	0.9	25	6.8	0.79	1.6
10/12/07	1,120,000	<10	<10	35	1	25	6.8	0.79	1.6
10/26/07	630	<10	560	45	3.1	25	6.9	NS	1.7
10/29/07	1,260	1700	10	30	2.0	25	6.8	0.73	1.9
10/31/07	4,500,000	120	40	35	1.2	25	6.8	0.74	1.8

Date	Fecal Coliform (cfu/100 mL)			Color	Turbidity (NTU)	Temperature (°C)	pH	Flow Rate (g/min)	DO (mg/L)
	Raw Influent	Effluent	UV Effluent						
11/02/07	9,800,000	3300	<20	30	2.3	25	6.9	0.74	1.9
11/05/07	1,000,000	70	250	35	1.6	25	6.9	0.74	2.0
11/07/07	4,900,000	5800	<10	30	2.8	25	6.9	0.73	1.9
11/09/07	4,400,000	<10	340	15	1.8	25	6.9	0.73	1.9
11/12/07	8,800,000	130	10	10	1.9	25	6.9	0.74	1.9
11/14/07	5,900,000	530	<10	40	1.1	24	6.9	0.73	1.8
11/16/07	4,550,000	40	<4	30	8.5	24	6.9	0.74	1.8
11/19/07	4,700,000	50	<2	35	3.4	25	6.9	0.74	1.8
11/21/07	3,900,000	570	<2	25	1.8	25	6.9	0.76	1.8
11/23/07	4,300,000	4300	6160	35	1.3	24	6.9	0.73	1.9
11/26/07	1,900,000	340	<2	5	3.1	24	6.9	0.74	1.8
11/28/07	5,300,000	<10	2	10	1.4	24	6.9	0.76	1.8
11/30/07	10,600,000	<10	<2	15	1.0	24	6.9	0.77	1.9
12/03/07	3,300,000	18	2	15	3.4	24	6.8	0.76	1.9
12/05/07	4,400,000	2	2	30	1.0	24	6.9	0.74	1.9
12/07/07	5,000,000	20	<1	15	0.9	24	6.9	0.73	1.9
12/10/07	4,150,000	16	294	30	1.8	24	6.9	0.73	1.8
12/12/07	3,800,000	<2	2	15	0.9	24	6.8	0.74	1.9
12/14/07	9,250,000	<2	<2	20	0.9	24	6.9	0.76	1.8
12/17/07	5,800,000	<2	<2	30	2.1	24	6.9	0.74	1.8
12/19/07	6,550,000	<2	<2	20	1.1	24	6.9	0.76	1.7
12/21/07	5,050,000	159	130	25	1.0	24	6.9	0.74	1.7
12/24/07	5,200,000	93	95	30	1.2	24	6.9	0.74	1.8
12/26/07	3,200,000	36	38	25	1.2	24	6.9	0.74	1.8
12/28/07	4,100,000	42	42	25	3.5	24	6.8	0.73	1.8
12/31/07	3,900,000	11	16	35	1.3	24	6.8	0.74	1.8

Date	Fecal Coliform (cfu/100 mL)			Color	Turbidity (NTU)	Temperature (°C)	pH	Flow Rate (g/min)	DO (mg/L)
	Raw Influent	Effluent	UV Effluent						
01/02/08	3,750,000	2	4	30	0.6	23	6.8	0.73	1.7
01/04/08	54,000,000	<2	<2	30	0.7	23	6.9	0.72	1.7
01/07/08	4,350,000	<2	<2	20	1.1	23	6.9	0.76	1.8
01/09/08	3,800,000	<2	<2	30	1.5	23	6.9	0.74	1.7
01/11/08	3,600,000	<2	<2	30	0.5	23	6.9	0.73	1.8
01/14/08	4,350,000	<2	<2	27	0.6	23	6.9	0.74	1.6
01/16/08	2,700,000	<2	<2	25	0.6	23	6.9	0.74	1.6
01/18/08	-	-	-	25	1.0	23	7	0.76	1.6
01/21/08	5,650,000	16	4	15	1.2	23	6.9	0.76	1.8
01/23/08	800,000	204	93	11	2.4	23	6.9	0.74	1.7
01/25/08	5,600,000	4	2	15	2.6	22	6.9	0.76	1.7
01/28/08	400,000	10	20	15	1.3	22	6.8	0.76	1.7
01/30/08	1,000,000	<2	<2	12	1.6	22	6.8	0.77	1.7