Environmental Express Stable Weigh Vessel
Total Dissolved Solids Report

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Table of Contents

Table of Figures

Introduction

This study report will cover the 3rd party laboratory, Askew Scientific Consulting LLC, evaluation of the Environmental Express Stable Weigh vessel for accuracy of recovery and comparison to traditional ceramic weighing dishes. Standard Methods for the Examination of Water and Wastewater 22nd Edition Total Dissolved Solids Dried at 180 °C: 2540 C was used. The results for 4 different sample types, Blank, 20 mg, 100 mg and 200 mg were determined for the Stable Weigh vessel and a 20 mg comparison sample set was run with the traditional porcelain weighing dish. The final results show that the Stable Weigh vessel is equivalent to the traditional porcelain weighing dishes and the results more precise.

Experimental Design

TDS Determination

1. Total Dissolved Solids were determined following Standard Methods for the Examination of Water and Wastewater 22nd Edition Total Dissolved Solids Dried at 180 °C: 2540 C with the following method clarifications:
2. The samples were dried to a solid material at 104 °C and then heated to 180 °C for 1 hour.
3. Blanks were prepared with 100 mL of high purity DI water which were transferred to the Stable Weigh vessel with a graduated cylinder.
4. Bulk TDS solutions were prepared with sodium chloride and Cellite to produce a sample with non-dissolved suspended solids to test the sample filtration.
5. 500 mg of Cellite was added to the 2 liter volumetric flask to produce the TDS test sample.
6. Sodium chloride of a set weight was added to the 2 liter volumetric flask to produce 50-mL aliquots of the final TDS weight needed:
7. The 2 liter test sample was then mixed and filtered into separate 1000 mL filter flasks.
8. The filtrate was then combined in a 4 liter beaker and stirred with 50 mL aliquots transferred with a wide tip pipet to the Stable Weigh vessel or evaporation dish.
9. The Stable Weigh vessels were placed in a 24-position rack and transferred to the drying oven at 104 °C. Evaporation dishes were placed on a pan and were transferred to the drying oven at 104 °C.
10. Once the samples were evaporated to dryness, then the oven temperature was raised to 180 °C and the samples were dried for 1 hour.

Figure 1: Stable Weigh Vessels in Drying Oven

Figure 2: Desiccator for Stable Weigh Vessels or Evaporation Dishes

11. Once the samples were at room temperature, they were transferred from the desiccator to the sample weighing balance station.
12. .The Mettler Toledo New Classic MS 5 place balance had the Mettler Toledo Haug Static control system in place to reduce static irregularities with sample weighing.


Figure 3: Mettler Toledo New Classic MS Balance with Haug Static Control System

13. .The cooled Stable Weigh vessels were of different shapes due to bag-sag when heated to 180 °C. These bags were difficult to position on the balance pan.

14. Bag placement devices were developed to hold the vessels. They consisted of aluminum U device or aluminum bent-pan device. Both worked well for the study.

Figure 4: Bag-Sag Vessels

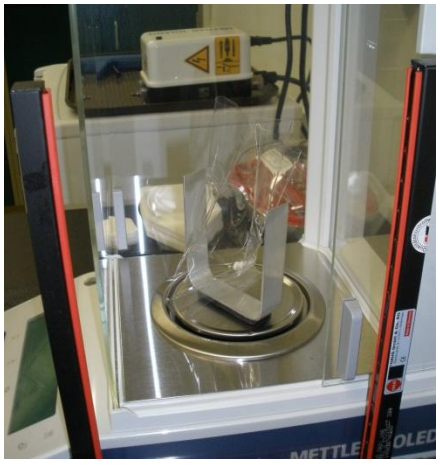
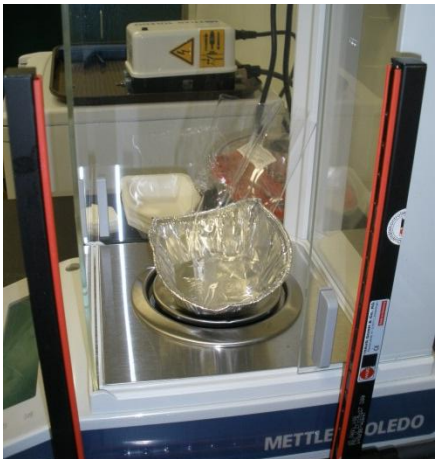

Figure 5: Vessel Holding U and Bent Aluminum Pan

15. Results are summarized in the next section.

Analytical Results

1. The results for 25 samples at each weight are summarized in Tables 1 through 5 below.
2. Major points from the tables:
3. Stable Weigh vessels:
    3.1. Blank showed an average weight change of -0.00002 % for 25 samples.
    3.2. Samples showed a standard deviation for an average weight change of 0.00508 % for 25 samples
    3.3. Samples showed a percent recovery of 100.03 % to 100.28 % for 25 samples.
    3.4. Samples showed a standard deviation for percent recovery of 0.29 % to 1.72 % for 25 samples.
4. Porcelain Evaporation Dishes
    4.1. Samples showed a percent recovery of 101.80 % for 25 samples.
    4.2. Samples showed a standard deviation for percent recovery of 2.99 % for 25 samples.

Table 1: Environmental Express TDS Stable-Weigh Tests Blank									
Analyst	**Edward F. Askew**								
Date	**4/14/2016**								
Blank									
Sample #	**Bag #**	**Volume (ml)**	**Initial weight (g)**	**Final weight 1 (g)**	**Final weight 2 (g)**	**Final weight 3 (g)**	**Two Consecutive Weights Difference (mg)**	**Final weight used (mg)**	**Percent Change**
1	**144**	100	3.7783	3.7785	3.7782		-0.3	3.7782	0.00265%
2	**145**	100	3.7329	3.7330	3.7329		-0.1	3.7329	0.00000%
3	**147**	100	3.8709	3.8709	3.8708		-0.1	3.8708	0.00258%
4	**148**	100	3.7953	3.7958	3.7955		-0.3	3.7955	-0.00527%
5	**150**	100	3.8747	3.8748	3.8745		-0.3	3.8745	0.00516%
6	**75**	100	3.7540	3.7543	3.7540		-0.3	3.7540	0.00000%
7	**58**	100	3.7246	3.7249	3.7245		-0.4	3.7245	0.00268%
8	**81**	100	3.7105	3.7107	3.7105		-0.2	3.7105	0.00000%
9	**82**	100	3.7503	3.7503	3.7503		0.0	3.7503	0.00000%
10	**83**	100	3.7500	3.7495	3.7497		0.2	3.7497	0.00800%
11	**94**	100	3.7312	3.7313	3.7316		0.3	3.7316	-0.01072%
12	**86**	100	3.7855	3.7854	3.7855		0.1	3.7855	0.00000%
13	**77**	100	3.9155	3.9153	3.9154		0.1	3.9154	0.00255%
14	**85**	100	3.7716	3.7716	3.7716		0.0	3.7716	0.00000%
15	**79**	100	3.8572	3.8574	3.8572		-0.2	3.8572	0.00000%
16	**111**	100	3.6931	3.6929	3.6931		0.2	3.6931	0.00000%
17	**53**	100	3.8009	3.8009	3.8009		0.0	3.8009	0.00000%
18	**74**	100	3.8078	3.8079	3.8079		0.0	3.8079	-0.00263%

Table 1: Environmental Express TDS Stable-Weigh Tests Blank									
Analyst	**Edward F. Askew**								
Date	**4/14/2016**								
Blank									
Sample #	**Bag #**	**Volume (ml)**	**Initial weight (g)**	**Final weight 1 (g)**	**Final weight 2 (g)**	**Final weight 3 (g)**	**Two Consecutive Weights Difference (mg)**	**Final weight used (mg)**	**Percent Change**
19	**52**	100	3.7902	3.7896	3.7900		0.4	3.7900	0.00528%
20	**80**	100	3.7825	3.7826	3.7825		-0.1	3.7825	0.00000%
21	**143**	100	3.7904	3.7907	3.7904		-0.3	3.7904	0.00000%
22	**42**	100	3.7561	3.7566	3.7566		0.0	3.7566	-0.01331%
23	**141**	100	3.8124	3.8124	3.8125		0.1	3.8125	-0.00262%
24	**140**	100	3.7322	3.7327	3.7324		-0.3	3.7324	-0.00536%
25	**139**	100	3.7765	3.7763	3.7761		-0.2	3.7761	0.01059%
								Average	-0.00002%
								Standard Deviation	0.00508%

Table 2: Environmental Express TDS Stable-Weigh Tests 200 mg										
Analyst	**Edward F. Askew**									
Date	**4/18/2016**									
200.03 mg per 50 mL										
Sample #	**Bag #**	**Volume (ml)**	**Initial weight (g)**	**Final weight 1 (g)**	**Final weight 2 (g)**	**Final weight 3 (g)**	**Two Consecutive Weights Difference (mg)**	**Final weight used (mg)**	**Final Solids Recovered Weight (mg)**	**Percent Recovery**
1	**188**	50	3.7495	3.9508	3.9505		-0.3	3.9505	201.0	100.50%
2	**187**	50	3.7712	3.9721	3.9718		-0.3	3.9718	200.6	100.30%
3	**186**	50	3.8070	4.0078	4.0076		-0.2	4.0076	200.6	100.30%
4	**185**	50	3.7333	3.9339	3.9338		-0.1	3.9338	200.5	100.25%
5	**184**	50	3.8077	4.0074	4.0073		-0.1	4.0073	199.6	99.80%
6	**182**	50	3.7256	3.9263	3.9260		-0.3	3.9260	200.4	100.20%
7	**183**	50	3.7304	3.9318	3.9314		-0.4	3.9314	201.0	100.50%
8	**181**	50	3.6925	3.8926	3.8926		0.0	3.8926	200.1	100.05%
9	**180**	50	3.7520	3.9522	3.9519		-0.3	3.9519	199.9	99.95%
10	**179**	50	3.7577	3.9580	3.9585		0.5	3.9585	200.8	100.40%
11	**178**	50	3.7507	3.9509	3.9506		-0.3	3.9506	199.9	99.95%
12	**177**	50	3.7350	3.9356	3.9360		0.4	3.9360	201.0	100.50%
13	**153**	50	3.7772	3.9776	3.9775		-0.1	3.9775	200.3	100.15%
14	**165**	50	3.8030	4.0027	4.0026		-0.1	4.0026	199.6	99.80%
15	**176**	50	3.7986	3.9986	3.9985		-0.1	3.9985	199.9	99.95%
16	**167**	50	3.7678	3.9679	3.9679		0.0	3.9679	200.1	100.05%
17	**168**	50	3.8320	4.0326	4.0324		-0.2	4.0324	200.4	100.20%
18	**166**	50	3.7805	3.9820	3.9816		-0.4	3.9816	201.1	100.55%

Table 2: Environmental Express TDS Stable-Weigh Tests 200 mg										
Analyst	**Edward F. Askew**									
Date	**4/18/2016**									
200.03 mg per 50 mL										
Sample #	**Bag #**	**Volume (ml)**	**Initial weight (g)**	**Final weight 1 (g)**	**Final weight 2 (g)**	**Final weight 3 (g)**	**Two Consecutive Weights Difference (mg)**	**Final weight used (mg)**	**Final Solids Recovered Weight (mg)**	**Percent Recovery**
19	**169**	50	3.7557	3.9559	3.9557		-0.2	3.9557	200.0	100.00%
20	**171**	50	3.7430	3.9435	3.9439		0.4	3.9439	200.9	100.45%
21	**170**	50	3.8467	4.0469	4.0467		-0.2	4.0467	200.0	100.00%
22	**172**	50	3.7228	3.9229	3.9228		-0.1	3.9228	200.0	100.00%
23	**174**	50	3.7589	3.9589	3.9585		-0.4	3.9585	199.6	99.80%
24	**138**	50	3.8743	4.0761	4.0757		-0.4	4.0757	201.4	100.70%
25	**163**	50	3.7442	3.9456	3.9458		0.2	3.9458	201.6	100.80%
								Average	200.4	100.21%
								Standard Deviation	0.6	0.29%

Table 3: Environmental Express TDS Stable-Weigh Tests 100 mg										
Analyst	**Edward F. Askew**									
Date	**4/20/2016**									
100.0 mg per 50 mL										
Sample #	**Bag #**	**Volume (ml)**	**Initial weight (g)**	**Final weight 1 (g)**	**Final weight 2 (g)**	**Final weight 3 (g)**	**Two Consecutive Weights Difference (mg)**	**Final weight used (mg)**	**Final Solids Recovered Weight (mg)**	**Percent Recovery**
1	**160**	50	3.8295	3.9296	3.9299		0.3	3.9299	100.4	100.40%
2	**159**	50	3.8089	3.9089	3.9090		0.1	3.9090	100.1	100.10%
3	**157**	50	3.8275	3.9276	3.9274		-0.2	3.9274	99.9	99.90%
4	**155**	50	3.7905	3.8908	3.8912		0.4	3.8912	100.7	100.70%
5	**132**	50	3.6963	3.7967	3.7964		-0.3	3.7964	100.1	100.10%
6	**126**	50	3.7543	3.8542	3.8541		-0.1	3.8541	99.8	99.80%
7	**121**	50	3.8094	3.9093	3.9092		-0.1	3.9092	99.8	99.80%
8	**154**	50	3.7894	3.8895	3.8898		0.3	3.8898	100.4	100.40%
9	**135**	50	3.7178	3.8179	3.8177		-0.2	3.8177	99.9	99.90%
10	**137**	50	3.7489	3.8488	3.8485		-0.3	3.8485	99.6	99.60%
11	**136**	50	3.7907	3.8907	3.8904		-0.3	3.8904	99.7	99.70%
12	**61**	50	3.8120	3.9121	3.9120		-0.1	3.9120	100.0	100.00%
13	**56**	50	3.7894	3.8890	3.8889		-0.1	3.8889	99.5	99.50%
14	**NA**	50	3.7348	3.8346	3.8344		-0.2	3.8344	99.6	99.60%
15	**69**	50	3.7634	3.8644	3.8648		0.4	3.8648	101.4	101.40%
16	**92**	50	3.8360	3.9362	3.9362		0.0	3.9362	100.2	100.20%
17	**96**	50	3.7731	3.8732	3.8732		0.0	3.8732	100.1	100.10%
18	**60**	50	3.7506	3.8504	3.8505		0.1	3.8505	99.9	99.90%

Table 3: Environmental Express TDS Stable-Weigh Tests 100 mg										
Analyst	**Edward F. Askew**									
Date	**4/20/2016**									
100.0 mg per 50 mL										
Sample #	**Bag #**	**Volume (ml)**	**Initial weight (g)**	**Final weight 1 (g)**	**Final weight 2 (g)**	**Final weight 3 (g)**	**Two Consecutive Weights Difference (mg)**	**Final weight used (mg)**	**Final Solids Recovered Weight (mg)**	**Percent Recovery**
19	**93**	50	3.7791	3.8791	3.8790		-0.1	3.8790	99.9	99.90%
20	**103**	50	3.7646	3.8638	3.8635		-0.3	3.8635	98.9	98.90%
21	**84**	50	3.7944	3.8945	3.8940		-0.5	3.8940	99.6	99.60%
22	**78**	50	3.8620	3.9630	3.9629		-0.1	3.9629	100.9	100.90%
23	**86**	50	3.7344	3.8343	3.8341		-0.2	3.8341	99.7	99.70%
24	**87**	50	3.7374	3.8379	3.8382		0.3	3.8382	100.8	100.80%
25	**161**	50	3.7346	3.8346	3.8344		-0.2	3.8344	99.8	99.80%
								Average	100.0	100.03%
								Standard Deviation	0.5	0.52%

Table 4: Environmental Express TDS Stable-Weigh Tests 20 mg										
Analyst	**Edward F. Askew**									
Date	**4/24/2016**									
20.1 mg per 50 mL										
Sample #	**Bag #**	**Volume (ml)**	**Initial weight (g)**	**Final weight 1 (g)**	**Final weight 2 (g)**	**Final weight 3 (g)**	**Two Consecutive Weights Difference (mg)**	**Final weight used (mg)**	**Final Solids Recovered Weight (mg)**	**Percent Recovery**
1	**195**	50	3.8442	3.8635	3.8632		-0.3	3.8632	19.0	94.53%
2	**194**	50	4.1223	4.1430	4.1431		0.1	4.1431	20.8	103.48%
3	**193**	50	3.9300	3.9498	3.9498		0.0	3.9498	19.8	98.51%
4	**191**	50	3.8884	3.9087	3.9087		0.0	3.9087	20.3	101.00%
5	**189**	50	3.9631	3.9836	3.9835		-0.1	3.9835	20.4	101.49%
6	**190**	50	3.7477	3.7681	3.7680		-0.1	3.7680	20.3	101.00%
7	**184**	50	3.8975	3.9170	3.9174		0.4	3.9174	19.9	99.00%
8	**188**	50	3.9284	3.9479	3.9482		0.3	3.9482	19.8	98.51%
9	**187**	50	3.8906	3.9112	3.9109		-0.3	3.9109	20.3	101.00%
10	**186**	50	3.9480	3.9680	3.9685		0.5	3.9685	20.5	101.99%
11	**209**	50	3.8724	3.8925	3.8929		0.4	3.8929	20.5	101.99%
12	**185**	50	3.9345	3.9543	3.9545		0.2	3.9545	20.0	99.50%
13	**210**	50	3.9015	3.9221	3.9217		-0.4	3.9217	20.2	100.50%
14	**219**	50	3.7434	3.7632	3.7635		0.3	3.7635	20.1	100.00%
15	**213**	50	3.7270	3.7472	3.7473		0.1	3.7473	20.3	101.00%
16	**212**	50	3.9431	3.9632	3.9633		0.1	3.9633	20.2	100.50%
17	**218**	50	3.7349	3.7549	3.7551		0.2	3.7551	20.2	100.50%
18	**217**	50	3.8864	3.9062	3.9064		0.2	3.9064	20.0	99.50%

Table 4: Environmental Express TDS Stable-Weigh Tests 20 mg										
Analyst	**Edward F. Askew**									
Date	**4/24/2016**									
20.1 mg per 50 mL										
Sample #	**Bag #**	**Volume (ml)**	**Initial weight (g)**	**Final weight 1 (g)**	**Final weight 2 (g)**	**Final weight 3 (g)**	**Two Consecutive Weights Difference (mg)**	**Final weight used (mg)**	**Final Solids Recovered Weight (mg)**	**Percent Recovery**
19	**216**	50	3.9130	3.9329	3.9331		0.2	3.9331	20.1	100.00%
20	**215**	50	3.7322	3.7522	3.7524		0.2	3.7524	20.2	100.50%
21	**214**	50	3.7237	3.7437	3.7437		0.0	3.7437	20.0	99.50%
22	**211**	50	3.7281	3.7486	3.7482		-0.4	3.7482	20.1	100.00%
23	**220**	50	3.7186	3.7394	3.7393		-0.1	3.7393	20.7	102.99%
24	**221**	50	3.7429	3.7629	3.7629		0.0	3.7629	20.0	99.50%
25	**196**	50	3.6729	3.6929	3.6931		0.2	3.6931	20.2	100.50%
								Average	20.2	100.28%
								Standard Deviation	0.3	1.72%

Table 5: Environmental Express TDS Stable-Weigh Tests 20 mg-Evaporation Dish										
Analyst	**Edward F. Askew**									
Date	**4/22/2016**									
20.2 mg per 50 mL (Evaporation Dish)										
Sample #	**Evaporation Dish #**	**Volume (ml)**	**Initial weight (g)**	**Final weight 1 (g)**	**Final weight 2 (g)**	**Final weight 3 (g)**	**Two Consecutive Weights Difference (mg)**	**Final weight used (mg)**	**Final Solids Recovered Weight (mg)**	**Percent Recovery**
1	**1**	50	80.0804	80.1007	80.1004		-0.3	80.1004	20.0	99.01%
2	**2**	50	88.0705	88.0913	88.0916		0.3	88.0916	21.1	104.46%
3	**3**	50	80.7484	80.7695	80.7698		0.3	80.7698	21.4	105.94%
4	**4**	50	80.6551	80.6759	80.6758		-0.1	80.6758	20.7	102.48%
5	**5**	50	80.1832	80.2041	80.2045		0.4	80.2045	21.3	105.45%
6	**6**	50	71.8200	71.8405	71.8410		0.5	71.8410	21.0	103.96%
7	**7**	50	77.3487	77.3690	77.3694		0.4	77.3694	20.7	102.48%
8	**8**	50	71.2989	71.3192	71.3190		-0.2	71.3190	20.1	99.50%
9	**9**	50	71.0469	71.0674	71.0670		-0.4	71.0670	20.1	99.50%
10	**10**	50	70.3869	70.4077	70.4072		-0.5	70.4072	20.3	100.50%
11	**11**	50	71.0414	71.0622	71.0618		-0.4	71.0618	20.4	100.99%
12	**12**	50	71.3383	71.3591	71.3589		-0.2	71.3589	20.6	101.98%
13	**13**	50	71.7408	71.7612	71.7612		0.0	71.7612	20.4	100.99%
14	**14**	50	70.1571	70.1774	70.1776		0.2	70.1776	20.5	101.49%
15	**15**	50	82.6046	82.6254	82.6256		0.2	82.6256	21.0	103.96%
16	**16**	50	70.3772	70.3975	70.3976		0.1	70.3976	20.4	100.99%
17	**17**	50	71.1090	71.1291	71.1294		0.3	71.1294	20.4	100.99%
18	**18**	50	69.7257	69.7460	69.7464		0.4	69.7464	20.7	102.48%

Table 5: Environmental Express TDS Stable-Weigh Tests 20 mg-Evaporation Dish										
Analyst	**Edward F. Askew**									
Date	**4/22/2016**									
20.2 mg per 50 mL (Evaporation Dish)										
Sample #	**Evaporation Dish #**	**Volume (ml)**	**Initial weight (g)**	**Final weight 1 (g)**	**Final weight 2 (g)**	**Final weight 3 (g)**	**Two Consecutive Weights Difference (mg)**	**Final weight used (mg)**	**Final Solids Recovered Weight (mg)**	**Percent Recovery**
19	**19**	50	88.4661	88.4867	88.4872		0.5	88.4872	21.1	104.46%
20	**20**	50	91.8973	91.9196	91.9191		-0.5	91.9191	21.8	107.92%
21	**21**	50	92.1109	92.1311	92.1312		0.1	92.1312	20.3	100.50%
22	**22**	50	93.7274	93.7480	93.7478		-0.2	93.7478	20.4	100.99%
23	**23**	50	92.0551	92.0755	92.0750		-0.5	92.0750	19.9	98.51%
24	**24**	50	94.5897	94.6106	94.6105		-0.1	94.6105	20.8	102.97%
25	**A**	50	83.3947	83.4134	83.4134		0.0	83.4134	18.7	92.57%
								Average	20.6	101.80%
								Standard Deviation	0.6	2.99%

Summary and Conclusions

Results from this study have shown:

1. Stable Weigh vessels can perform Standard Methods for the Examination of Water and Wastewater 22nd Edition Total Dissolved Solids Dried at 180 °C: 2540 C with equivalent results as the traditional porcelain weighing dish.
2. Stable Weigh vessel results have a percent recovery and standard deviation that is more precise that the results obtained with the traditional porcelain weighing dishes.
3. Precision (%RSD) comparison for 20 mg samples shows the Stable Weigh to be more precise.

    3.1. %RSD 20 mg Stable Weigh 1.49 %

    3.2. %RSD 20 mg Evaporation Dish 2.91 %

Appendixes

Appendix 1: Standard Methods for the Examination of Water and Wastewater 22nd Edition Total Dissolved Solids Dried at 180 °C: 2540 C

2540 C. Total Dissolved Solids Dried at 180°C

1. General Discussion

a. Principle: A well-mixed sample is filtered through a standard glass fiber filter, and the filtrate is evaporated to dryness in a weighed dish and dried to constant weight at 180°C. The increase in dish weight represents the total dissolved solids. This procedure may be used for drying at other temperatures.

The results may not agree with the theoretical value for solids calculated from chemical analysis of sample (see above). Approximate methods for correlating chemical analysis with dissolved solids are available.[1] The filtrate from the total suspended solids determination (2540D) may be used for determination of total dissolved solids.

b. Interferences: See 2540A.2 and 2540B.1*b*. Highly mineralized waters with a considerable calcium, magnesium, chloride, and/or sulfate content may be hygroscopic and require prolonged drying, proper desiccation, and rapid weighing. Samples high in bicarbonate require careful and possibly prolonged drying at 180°C to insure complete conversion of bicarbonate to carbonate. Because excessive residue in the dish may form a water-trapping crust, limit sample to no more than 200 mg residue.

c. Quality control (QC): The QC practices considered to be an integral part of each method are summarized in Tables 2020:I and II.

2. Apparatus

Apparatus listed in 2540B.2*a–h* is required, and in addition:

*a. Glass-fiber filter disks** without organic binder.

b. Filtration apparatus: One of the following, suitable for the filter disk selected:

1) *Membrane filter funnel.*

2) *Gooch crucible,* 25-mL to 40-mL capacity, with Gooch crucible adapter.

3) *Filtration apparatus* with reservoir and coarse (40- to 60-μm) fritted disk as filter support.†

c. Suction flask, of sufficient capacity for sample size selected.

d. Drying oven, for operation at 180 ± 2°C.

3. Procedure

a. Preparation of glass-fiber filter disk: If pre-prepared glass fiber filter disks are used, eliminate this step. Insert disk with wrinkled side up into filtration apparatus. Apply vacuum and wash disk with three successive 20-mL volumes of reagent-grade water. Continue suction to remove all traces of water. Discard washings.

b. Preparation of evaporating dish: If volatile solids are to be measured, ignite cleaned evaporating dish at 550°C for 1 h in a muffle furnace. If only total dissolved solids are to be measured, heat clean dish to 180 ± 2°C for 1 h in an oven. Store in desiccator until needed. Weigh immediately before use.

c. Selection of filter and sample sizes: Choose sample volume to yield between 2.5 and 200 mg dried residue. If more than 10 min are required to complete filtration, increase filter size or decrease sample volume.

d. Sample analysis: Stir sample with a magnetic stirrer and pipet a measured volume onto a glass-fiber filter with applied vacuum. Wash with three successive 10-mL volumes of reagent-grade water, allowing complete drainage between washings, and continue suction for about 3 min after filtration is complete. Transfer total filtrate (with washings) to a weighed evaporating dish and evaporate to dryness on a steam bath or in a drying oven. If necessary, add successive portions to the same dish after evaporation. Dry evaporated sample for at least 1 h in an oven at 180 ± 2°C, cool in a desiccator to balance temperature, and weigh. Repeat drying cycle of drying, cooling, desiccating, and weighing until a constant weight is obtained or until weight change is less than 4% of previous weight or 0.5 mg, whichever is less. Analyze at least 10% of all samples in duplicate. Duplicate determinations should agree within 5% of their average weight. If volatile solids are to be determined, follow procedure in 2540E.

4. Calculation

$$\text{mg total dissolved solids/L} = \frac{(A - B) \times 1000}{\text{sample volume, mL}}$$

where:

A = weight of dried residue + dish, mg, and
B = weight of dish, mg.

5. Precision

Single-laboratory analyses of 77 samples of a known of 293 mg/L were made with a standard deviation of differences of 21.20 mg/L.

6. Reference

1. Sokolow, V.P. 1933. Water of crystallization in total solids of water analysis. *Ind. Eng. Chem.,* Anal. Ed. 5:336.

7. Bibliography

Howard, C.S. 1933. Determination of total dissolved solids in water analysis. *Ind. Eng. Chem.,* Anal. Ed. 5:4.

U.S. Geological Survey. 1974. Methods for Collection and Analysis of Water Samples for Dissolved Minerals and Gases. Techniques of Water-Resources Investigations, Book 5, Chap. A1. U.S. Geological Surv., Washington, D.C.

* Whatman grade 934AH; Gelman type A/E; Millipore type AP40; E-D Scientific Specialties grade 161; Environmental Express Pro Weigh; or other products that give demonstrably equivalent results. Practical filter diameters are 2.2 to 12.5 cm.
† Gelman No. 4201 or equivalent.