

Appendix K Water Formulation Recipes

The pages which follow contain recipes for formulation of water with the properties of the indicated cities from calcium carbonate, calcium chloride, sodium chloride, sodium bicarbonate, calcium sulfate, and magnesium sulfate. Where the use of magnesium carbonate appreciably improves the accuracy of a formulation we give separate recipes: one with magnesium carbonate and one without. None of these formulations require the addition of acid but it is assumed that calcium carbonate (chalk) and magnesium carbonate (where used) is dissolved by sparging the entire volume of water being prepared with carbon dioxide or by first dissolving the chalk in carbonic acid made by pressurizing cold water in a cornelius keg with CO₂ and shaking. All the recipes use deionized water as the **base water**.

The formulations are designed to get the concentrations of all dissolved species as close to the desired levels as possible. As we indicated in Part III it is often not possible to get very close at all. We recommend choice of the profile for a particular city which gives the best, in the sense of closest approximation, synthesis.

Salt quantities specified are in milligrams per liter.

The individual recipes are output from the FORTRAN program of Appendix J. Individual items should be familiar. At the top of the page we list the city name and im balance information in terms of the pH required to achieve electrical neutrality where the profile can be balanced at reasonable pH and, where it cannot, the imbalance at pH 8.4. Note that if pH has been set to 8.4 the profile synthesized will be electrically balanced as all real water samples must be but that one or more ions will be in appreciable error.

The next block of data gives the amounts of the salts to be added to 1 liter of water in milligrams. The carbonic acid is in terms of the number of milliequivalents of hydrogen ions required from dissolved CO₂ to dissolve the carbonates and bring the pH to the balancing value or pH 8.4 if balance could not be achieved at a lower pH.

The bottom of the individual pages compare the target profile and the water synthesized by adding the specified amounts of salts. pH is self explanatory. f1, f2, and f3 are the **mole fractions** for the **carbo** species distribution at the given pH as described in Appendix D. Ionic strength is as described in Appendix D. The "carbonates" values are values for C_i , i.e. the total moles of carbo per liter. This is the first entry for which values are given in the last 2 columns. These columns quantify the error i.e. the difference in the desired amount of carbo as given in the first column compared to the amount of carbo realized by the synthesis. In the fourth column the value is the log to the base 10 of the ratio. For example if 2 were desired and 4 realized the fourth column would show 0.3. In the fifth column the value is the percentage error. For example if 1 were desired and 1.5 realized the fifth column would display 50%.

The remainder of this data block compares the desired and realized concentrations of other ions. Where an item is marked by an asterisk the fourth column values are used to compute an overall error by summing the squares of the fourth column values, dividing by 6 and taking the square root. The algorithm which computes the salt additions strives to make this number as small as possible. It is reported as "RMS Log Error" and an equivalent overall percentage error is also computed.

At the bottom of the page we give, for the target and synthesis water, the **saturation pH**, the **Langelier** and **Ryznar** indices and indicate whether the waters are saturated with respect to calcium carbonate. The similar **equilibrium pH** and CO₂ **equilibrium indices** are also given as is an indication as to whether the waters are saturated with respect to CO₂. The final entry gives values for Kohlbach's **residual alkalinity**.

K.1 Antwerp

Target City: Antwerp Base Water: Deionized
 Balancing pH 11.0662 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 2.3906 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	43.45 mg/L
Calcium Sulfate Dihydrate	:	112.67 mg/L
Calcium Chloride Dihydrate	:	87.69 mg/L
Magnesium Sulfate Heptahydrate	:	102.96 mg/L
Calcium Carbonate	:	39.07 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	55.86 mg/L
Carbonic Acid	:	0.75 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Antwerp			
pH	: 8.40	8.40		
f1	: 0.0079	0.0079		
f2	: 0.9765	0.9766		
f3	: 0.0156	0.0155		
Ionic Strength	: 9.3930	8.6689		
pfm	: 0.0450	0.0434		
Carbonates*	: 1.2459	1.4317 mM/L	+0.0604	+14.91%
Calcium*	: 90.00	65.78 mg/L	-0.1362	-26.91%
Carbonic	: 0.61	0.70 mg/L	+0.0620	+15.35%
Bicarbonate	: 74.25	85.33 mg/L	+0.0604	+14.93%
Carbonate	: 1.17	1.33 mg/K	+0.0556	+13.65%
Alkalinity (as CaCO3)	: 65.08	74.33 mg/L		
Chloride*	: 57.00	68.65 mg/L	+0.0807	+20.43%
Magnesium*	: 11.00	10.15 mg/L	-0.0348	-7.70%
Sodium*	: 37.00	32.38 mg/L	-0.0579	-12.49%
Sulfate*	: 84.00	102.99 mg/L	+0.0885	+22.60%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.08276	Corresponding %	20.9943	
pHs	: 7.64	7.71		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 0.76	0.69	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 6.88	7.01	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHc	: 8.38	8.45		
Saturated WRT CO2?	: No	Yes		
CO2 Equilibrium Index:	-0.02	0.05	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: -5.54	21.47 mg/L as CaCO3		

K.2 Brugge

Target City: Brugge Base Water: Deionized
 Balancing pH 8.3989 is within acceptable bounds
 Net charge (imbalance) at this pH: 0.0000 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	4.66 mg/L
Calcium Sulfate Dihydrate	:	85.38 mg/L
Calcium Chloride Dihydrate	:	72.96 mg/L
Magnesium Sulfate Heptahydrate	:	131.89 mg/L
Calcium Carbonate	:	230.38 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	66.40 mg/L
Carbonic Acid	:	4.50 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Brugge			
pH	: 8.40	8.40		
f1	: 0.0077	0.0077		
f2	: 0.9758	0.9758		
f3	: 0.0165	0.0165		
Ionic Strength	: 13.4297	13.4321		
pfm	: 0.0528	0.0528		
Carbonates*	: 5.3443	5.3444 mM/L	+0.0000	+0.00%
Calcium*	: 132.00	132.02 mg/L	+0.0001	+0.01%
Carbonic	: 2.57	2.57 mg/L	+0.0000	+0.00%
Bicarbonate	: 318.26	318.27 mg/L	+0.0000	+0.00%
Carbonate	: 5.28	5.28 mg/K	+0.0000	+0.01%
Alkalinity (as CaCO3)	: 269.86	269.86 mg/L		
Chloride*	: 38.00	38.01 mg/L	+0.0001	+0.03%
Magnesium*	: 13.00	13.01 mg/L	+0.0002	+0.04%
Sodium*	: 20.00	20.00 mg/L	+0.0001	+0.02%
Sulfate*	: 99.00	99.04 mg/L	+0.0002	+0.04%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.00012	Corresponding %	0.0271	
pHs	: 6.88	6.88		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 1.52	1.52	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 5.36	5.36	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 9.01	9.01		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.61	0.61	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: 168.11	168.11 mg/L as CaCO3		

K.3 Brussels

Target City: Brussels Base Water: Deionized
 Balancing pH 8.0827 is within acceptable bounds
 Net charge (imbalance) at this pH: 0.0000 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	10.60 mg/L
Calcium Sulfate Dihydrate	:	47.54 mg/L
Calcium Chloride Dihydrate	:	71.68 mg/L
Magnesium Sulfate Heptahydrate	:	111.50 mg/L
Calcium Carbonate	:	173.26 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	50.54 mg/L
Carbonic Acid	:	3.53 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Brussels			
pH	: 8.08	8.08		
f1	: 0.0163	0.0163		
f2	: 0.9761	0.9761		
f3	: 0.0076	0.0076		
Ionic Strength	: 10.3686	10.3668		
pfm	: 0.0470	0.0470		
Carbonates*	: 4.0984	4.0976 mM/L	-0.0001	-0.02%
Calcium*	: 100.00	99.99 mg/L	+0.0000	-0.01%
Carbonic	: 4.13	4.13 mg/L	-0.0001	-0.02%
Bicarbonate	: 244.15	244.10 mg/L	-0.0001	-0.02%
Carbonate	: 1.88	1.88 mg/K	-0.0001	-0.02%
Alkalinity (as CaCO3)	: 203.99	203.96 mg/L		
Chloride*	: 41.00	41.00 mg/L	+0.0000	-0.01%
Magnesium*	: 11.00	11.00 mg/L	-0.0002	-0.04%
Sodium*	: 18.00	18.00 mg/L	+0.0000	+0.00%
Sulfate*	: 70.00	69.98 mg/L	-0.0001	-0.03%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.00010	Corresponding %	0.0223	
pHs	: 7.09	7.09		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 1.00	1.00	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 6.09	6.09	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 8.90	8.90		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.82	0.82	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: 126.24	126.22 mg/L as CaCO3		

K.4 Burton 1

Target City: Burton1 Base Water: Deionized
 Balancing pH 9.9494 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 1.9571 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	47.78 mg/L
Calcium Sulfate Dihydrate	:	794.34 mg/L
Calcium Chloride Dihydrate	:	14.89 mg/L
Magnesium Sulfate Heptahydrate	:	613.98 mg/L
Calcium Carbonate	:	158.45 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	126.43 mg/L
Carbonic Acid	:	3.04 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Burton1			
pH	: 8.40	8.40		
f1	: 0.0072	0.0072		
f2	: 0.9728	0.9728		
f3	: 0.0199	0.0200		
Ionic Strength	: 35.7535	35.8240		
pfm	: 0.0807	0.0807		
Carbonates*	: 4.5082	4.6093 mM/L	+0.0096	+2.24%
Calcium*	: 268.00	252.43 mg/L	-0.0260	-5.81%
Carbonic	: 2.02	2.06 mg/L	+0.0096	+2.23%
Bicarbonate	: 267.66	273.66 mg/L	+0.0096	+2.24%
Carbonate	: 5.40	5.52 mg/K	+0.0098	+2.29%
Alkalinity (as CaCO3)	: 229.06	234.13 mg/L		
Chloride*	: 36.00	36.17 mg/L	+0.0020	+0.46%
Magnesium*	: 62.00	60.55 mg/L	-0.0103	-2.34%
Sodium*	: 54.00	53.39 mg/L	-0.0049	-1.12%
Sulfate*	: 638.00	682.49 mg/L	+0.0293	+6.97%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.01713	Corresponding %	4.0224	
pHs	: 6.79	6.80		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 1.61	1.60	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 5.17	5.21	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHc	: 8.90	8.91		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.50	0.51	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: 1.56	18.59 mg/L as CaCO3		

K.5 Burton 2

Target City: Burton2 Base Water: Deionized
 Balancing pH 10.2070 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 1.9895 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	24.70 mg/L
Calcium Sulfate Dihydrate	:	816.77 mg/L
Calcium Chloride Dihydrate	:	52.36 mg/L
Magnesium Sulfate Heptahydrate	:	594.12 mg/L
Calcium Carbonate	:	122.84 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	73.43 mg/L
Carbonic Acid	:	2.37 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Burton2			
pH	: 8.40	8.40		
f1	: 0.0072	0.0072		
f2	: 0.9730	0.9730		
f3	: 0.0198	0.0198		
Ionic Strength	: 34.6090	34.6857		
pfm	: 0.0796	0.0796		
Carbonates*	: 3.2295	3.2843 mM/L	+0.0073	+1.70%
Calcium*	: 270.00	253.60 mg/L	-0.0272	-6.07%
Carbonic	: 1.45	1.47 mg/L	+0.0072	+1.68%
Bicarbonate	: 191.77	195.02 mg/L	+0.0073	+1.70%
Carbonate	: 3.84	3.91 mg/K	+0.0075	+1.75%
Alkalinity (as CaCO3)	: 164.95	167.70 mg/L		
Chloride*	: 40.00	40.23 mg/L	+0.0025	+0.59%
Magnesium*	: 60.00	58.59 mg/L	-0.0103	-2.35%
Sodium*	: 30.00	29.81 mg/L	-0.0027	-0.63%
Sulfate*	: 640.00	687.26 mg/L	+0.0309	+7.38%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.01766	Corresponding %	4.1511	
pHs	: 6.92	6.94		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 1.48	1.46	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 5.45	5.49	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 8.76	8.77		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.36	0.37	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: -62.79	-47.53 mg/L as CaCO3		

K.6 Burton 3

Target City: Burton3 Base Water: Deionized
 Balancing pH 8.4952 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 0.0317 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	40.18	mg/L
Calcium Sulfate Dihydrate	:	982.01	mg/L
Calcium Chloride Dihydrate	:	1.25	mg/L
Magnesium Sulfate Heptahydrate	:	456.16	mg/L
Calcium Carbonate	:	164.26	mg/L
Magnesium Carbonate	:	0.00	mg/L
Sodium Bicarbonate	:	143.16	mg/L
Carbonic Acid	:	3.15	mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Burton3			
pH	: 8.40	8.40		
f1	: 0.0072	0.0072		
f2	: 0.9726	0.9726		
f3	: 0.0202	0.0202		
Ionic Strength	: 37.5901	37.5891		
pfm	: 0.0824	0.0824		
Carbonates*	: 4.9180	4.9195 mM/L	+0.0001	+0.03%
Calcium*	: 295.00	294.72 mg/L	-0.0004	-0.09%
Carbonic	: 2.19	2.19 mg/L	+0.0001	+0.03%
Bicarbonate	: 291.93	292.02 mg/L	+0.0001	+0.03%
Carbonate	: 5.96	5.96 mg/K	+0.0001	+0.03%
Alkalinity (as CaCO3)	: 249.66	249.73 mg/L		
Chloride*	: 25.00	24.98 mg/L	-0.0004	-0.10%
Magnesium*	: 45.00	44.98 mg/L	-0.0002	-0.04%
Sodium*	: 55.00	54.98 mg/L	-0.0001	-0.03%
Sulfate*	: 725.00	725.68 mg/L	+0.0004	+0.09%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.00031	Corresponding %	0.0715	
pHs	: 6.72	6.72		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 1.68	1.68	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 5.03	5.03	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 8.94	8.94		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.54	0.54	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: 12.91	13.19 mg/L as CaCO3		

K.7 Burton 4

Target City: Burton4 Base Water: Deionized
 Balancing pH 6.6220 is within acceptable bounds
 Net charge (imbalance) at this pH: 0.0000 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	24.83	mg/L
Calcium Sulfate Dihydrate	:	1311.68	mg/L
Calcium Chloride Dihydrate	:	1.93	mg/L
Magnesium Sulfate Heptahydrate	:	243.18	mg/L
Calcium Carbonate	:	108.05	mg/L
Magnesium Carbonate	:	0.00	mg/L
Sodium Bicarbonate	:	124.96	mg/L
Carbonic Acid	:	5.38	mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Burton4			
pH	: 6.62	6.62		
f1	: 0.3063	0.3063		
f2	: 0.6935	0.6934		
f3	: 0.0002	0.0002		
Ionic Strength	: 39.6497	39.5003		
pfm	: 0.0842	0.0841		
Carbonates*	: 5.2459	5.2549 mM/L	+0.0007	+0.17%
Calcium*	: 352.00	349.14 mg/L	-0.0035	-0.81%
Carbonic	: 99.66	99.85 mg/L	+0.0008	+0.19%
Bicarbonate	: 222.03	222.39 mg/L	+0.0007	+0.16%
Carbonate	: 0.08	0.08 mg/K	+0.0003	+0.07%
Alkalinity (as CaCO3)	: 182.26	182.55 mg/L		
Chloride*	: 16.00	15.99 mg/L	-0.0002	-0.05%
Magnesium*	: 24.00	23.98 mg/L	-0.0003	-0.08%
Sodium*	: 44.00	43.97 mg/L	-0.0003	-0.08%
Sulfate*	: 820.00	826.62 mg/L	+0.0035	+0.81%
Nitrate	: 18.00	0.00 mg/L		
RMS Log Error (Items with *):	0.00206	Corresponding %	0.4761	
pHs	: 6.77	6.77		
Saturated WRT CaCO3?	: No	No		
Langelier Index	: -0.15	-0.15	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 6.91	6.92	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHc	: 8.82	8.82		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	2.20	2.20	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: -82.79	-80.45 mg/L as CaCO3		

K.8 Burton 5

Target City: Burton5 Base Water: Deionized
 Balancing pH 10.6984 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 3.2026 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	59.58 mg/L
Calcium Sulfate Dihydrate	:	863.23 mg/L
Calcium Chloride Dihydrate	:	0.33 mg/L
Magnesium Sulfate Heptahydrate	:	604.96 mg/L
Calcium Carbonate	:	106.34 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	108.11 mg/L
Carbonic Acid	:	2.03 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Burton5			
pH	: 8.40	8.40		
f1	: 0.0072	0.0072		
f2	: 0.9729	0.9729		
f3	: 0.0199	0.0199		
Ionic Strength	: 35.1229	35.3948		
pfm	: 0.0801	0.0803		
Carbonates*	: 3.2787	3.3661 mM/L	+0.0114	+2.67%
Calcium*	: 268.00	243.62 mg/L	-0.0414	-9.10%
Carbonic	: 1.47	1.51 mg/L	+0.0112	+2.60%
Bicarbonate	: 194.68	199.86 mg/L	+0.0114	+2.66%
Carbonate	: 3.91	4.02 mg/K	+0.0122	+2.85%
Alkalinity (as CaCO3)	: 167.43	171.82 mg/L		
Chloride*	: 36.00	36.30 mg/L	+0.0036	+0.84%
Magnesium*	: 62.00	59.66 mg/L	-0.0167	-3.78%
Sodium*	: 54.00	53.03 mg/L	-0.0079	-1.80%
Sulfate*	: 638.00	717.40 mg/L	+0.0509	+12.45%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.02827	Corresponding %	6.7271	
pHs	: 6.92	6.95		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 1.48	1.45	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 5.45	5.51	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHc	: 8.77	8.78		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.37	0.38	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: -60.07	-36.92 mg/L as CaCO3		

K.9 Burton 6

Target City: Burton6 Base Water: Deionized
 Balancing pH 10.5159 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 3.4301 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	11.35 mg/L
Calcium Sulfate Dihydrate	:	641.03 mg/L
Calcium Chloride Dihydrate	:	59.18 mg/L
Magnesium Sulfate Heptahydrate	:	390.77 mg/L
Calcium Carbonate	:	183.86 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	73.89 mg/L
Carbonic Acid	:	3.56 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Burton6			
pH	: 8.40	8.40		
f1	: 0.0073	0.0073		
f2	: 0.9735	0.9736		
f3	: 0.0191	0.0191		
Ionic Strength	: 29.6073	29.0576		
pfm	: 0.0745	0.0739		
Carbonates*	: 4.2623	4.4974 mM/L	+0.0233	+5.52%
Calcium*	: 275.00	238.99 mg/L	-0.0610	-13.10%
Carbonic	: 1.94	2.05 mg/L	+0.0239	+5.67%
Bicarbonate	: 253.24	267.23 mg/L	+0.0233	+5.52%
Carbonate	: 4.89	5.14 mg/K	+0.0216	+5.09%
Alkalinity (as CaCO3)	: 216.52	228.28 mg/L		
Chloride*	: 35.00	35.43 mg/L	+0.0053	+1.22%
Magnesium*	: 40.00	38.53 mg/L	-0.0162	-3.66%
Sodium*	: 25.00	24.69 mg/L	-0.0055	-1.25%
Sulfate*	: 450.00	509.95 mg/L	+0.0543	+13.32%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.03543	Corresponding %	8.4995	
pHs	: 6.77	6.80		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 1.63	1.60	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 5.14	5.21	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 8.89	8.91		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.49	0.51	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: -3.03	35.25 mg/L as CaCO3		

K.10 Dortmund 1

Target City: Dortmund1 Base Water: Deionized
 Balancing pH 11.6915 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 9.2751 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	41.63 mg/L
Calcium Sulfate Dihydrate	:	55.13 mg/L
Calcium Chloride Dihydrate	:	94.64 mg/L
Magnesium Sulfate Heptahydrate	:	325.54 mg/L
Calcium Carbonate	:	229.98 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	123.15 mg/L
Carbonic Acid	:	4.47 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET Dortmund1	SYNTHESIS	pRatio	Pct Err
pH	: 8.40	8.40		
f1	: 0.0075	0.0076		
f2	: 0.9746	0.9751		
f3	: 0.0179	0.0173		
Ionic Strength	: 21.0274	17.6116		
pfm	: 0.0644	0.0596		
Carbonates*	: 3.6230	5.9965 mM/L	+0.2188	+65.51%
Calcium*	: 225.00	130.73 mg/L	-0.2358	-41.90%
Carbonic	: 1.69	2.83 mg/L	+0.2238	+67.43%
Bicarbonate	: 215.50	356.86 mg/L	+0.2190	+65.60%
Carbonate	: 3.88	6.22 mg/K	+0.2047	+60.21%
Alkalinity (as CaCO3)	: 184.22	302.72 mg/L		
Chloride*	: 60.00	70.89 mg/L	+0.0724	+18.15%
Magnesium*	: 40.00	32.10 mg/L	-0.0955	-19.74%
Sodium*	: 60.00	50.08 mg/L	-0.0785	-16.54%
Sulfate*	: 120.00	157.63 mg/L	+0.1185	+31.36%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.15170	Corresponding %	41.8065	
pHs	: 6.88	6.87		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 1.52	1.53	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 5.35	5.34	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 8.83	9.05		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.43	0.65	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: 0.31	190.66 mg/L as CaCO3		

K.11 Dortmund 2

Target City: Dortmund2 Base Water: Deionized
 Balancing pH 8.0161 is within acceptable bounds
 Net charge (imbalance) at this pH: 0.0000 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	51.11	mg/L
Calcium Sulfate Dihydrate	:	324.78	mg/L
Calcium Chloride Dihydrate	:	143.09	mg/L
Magnesium Sulfate Heptahydrate	:	253.53	mg/L
Calcium Carbonate	:	338.18	mg/L
Magnesium Carbonate	:	0.00	mg/L
Sodium Bicarbonate	:	182.31	mg/L
Carbonic Acid	:	6.94	mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET Dortmund2	SYNTHESIS	pRatio	Pct Err
pH	: 8.02	8.02		
f1	: 0.0178	0.0178		
f2	: 0.9744	0.9744		
f3	: 0.0078	0.0078		
Ionic Strength	: 27.7725	27.7750		
pfm	: 0.0725	0.0725		
Carbonates*	: 9.0164	9.0169 mM/L	+0.0000	+0.01%
Calcium*	: 250.00	250.04 mg/L	+0.0001	+0.01%
Carbonic	: 9.98	9.98 mg/L	+0.0000	+0.01%
Bicarbonate	: 536.16	536.19 mg/L	+0.0000	+0.01%
Carbonate	: 4.22	4.22 mg/K	+0.0000	+0.01%
Alkalinity (as CaCO3)	: 444.65	444.68 mg/L		
Chloride*	: 100.00	100.01 mg/L	+0.0000	+0.01%
Magnesium*	: 25.00	25.00 mg/L	+0.0000	+0.00%
Sodium*	: 70.00	70.00 mg/L	+0.0000	+0.00%
Sulfate*	: 280.00	280.02 mg/L	+0.0000	+0.01%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.00003	Corresponding %	0.0079	
pHs	: 6.48	6.47		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 1.54	1.54	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 4.93	4.93	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 9.21	9.21		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	1.20	1.20	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: 251.73	251.73 mg/L as CaCO3		

K.12 Dortmund 3

Target City: Dortmund3 Base Water: Deionized
 Balancing pH 11.3071 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 5.0493 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	61.33	mg/L
Calcium Sulfate Dihydrate	:	580.29	mg/L
Calcium Chloride Dihydrate	:	38.39	mg/L
Magnesium Sulfate Heptahydrate	:	247.38	mg/L
Calcium Carbonate	:	82.26	mg/L
Magnesium Carbonate	:	0.00	mg/L
Sodium Bicarbonate	:	130.41	mg/L
Carbonic Acid	:	1.57	mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET Dortmund3	SYNTHESIS	pRatio	Pct Err
pH	: 8.40	8.40		
f1	: 0.0074	0.0075		
f2	: 0.9742	0.9743		
f3	: 0.0184	0.0182		
Ionic Strength	: 24.5823	23.3693		
pfm	: 0.0688	0.0674		
Carbonates*	: 2.8525	3.1583 mM/L	+0.0442	+10.72%
Calcium*	: 237.00	178.49 mg/L	-0.1231	-24.69%
Carbonic	: 1.31	1.46 mg/L	+0.0458	+11.12%
Bicarbonate	: 169.59	187.80 mg/L	+0.0443	+10.74%
Carbonate	: 3.15	3.45 mg/K	+0.0399	+9.61%
Alkalinity (as CaCO3)	: 145.80	161.06 mg/L		
Chloride*	: 53.00	55.72 mg/L	+0.0217	+5.12%
Magnesium*	: 26.00	24.39 mg/L	-0.0277	-6.18%
Sodium*	: 65.00	59.82 mg/L	-0.0361	-7.98%
Sulfate*	: 318.00	420.18 mg/L	+0.1210	+32.13%
Nitrate	: 46.00	0.00 mg/L		
RMS Log Error (Items with *):	0.07561	Corresponding %	19.0173	
pHs	: 6.98	7.05		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 1.42	1.35	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 5.56	5.70	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 8.72	8.76		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.32	0.36	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: -38.44	19.48 mg/L as CaCO3		

K.13 Dortmund 4

Target City: Dortmund4 Base Water: Deionized
 Balancing pH 11.7818 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 9.9544 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	46.86	mg/L
Calcium Sulfate Dihydrate	:	93.29	mg/L
Calcium Chloride Dihydrate	:	95.44	mg/L
Magnesium Sulfate Heptahydrate	:	312.87	mg/L
Calcium Carbonate	:	182.94	mg/L
Magnesium Carbonate	:	0.00	mg/L
Sodium Bicarbonate	:	109.31	mg/L
Carbonic Acid	:	3.55	mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Dortmund4			
pH	: 8.40	8.40		
f1	: 0.0075	0.0076		
f2	: 0.9747	0.9752		
f3	: 0.0178	0.0171		
Ionic Strength	: 20.6826	16.8154		
pfm	: 0.0639	0.0584		
Carbonates*	: 2.9508	4.9033 mM/L	+0.2205	+66.17%
Calcium*	: 225.00	120.99 mg/L	-0.2694	-46.23%
Carbonic	: 1.38	2.32 mg/L	+0.2263	+68.39%
Bicarbonate	: 175.53	291.84 mg/L	+0.2208	+66.26%
Carbonate	: 3.15	5.05 mg/K	+0.2042	+60.03%
Alkalinity (as CaCO3)	: 150.60	248.04 mg/L		
Chloride*	: 60.00	74.45 mg/L	+0.0937	+24.08%
Magnesium*	: 40.00	30.85 mg/L	-0.1128	-22.87%
Sodium*	: 60.00	48.35 mg/L	-0.0938	-19.42%
Sulfate*	: 120.00	173.99 mg/L	+0.1613	+44.99%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.17202	Corresponding %	48.6021	
pHs	: 6.96	6.98		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 1.44	1.42	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 5.53	5.57	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 8.74	8.96		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.34	0.56	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: -33.32	143.65 mg/L as CaCO3		

K.14 Dublin 1

Target City: Dublin1 Base Water: Deionized
 Balancing pH 10.7277 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 2.5702 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	0.84 mg/L
Calcium Sulfate Dihydrate	:	76.60 mg/L
Calcium Chloride Dihydrate	:	40.03 mg/L
Magnesium Sulfate Heptahydrate	:	39.58 mg/L
Calcium Carbonate	:	142.42 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	40.98 mg/L
Carbonic Acid	:	2.79 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Dublin1			
pH	: 8.40	8.40		
f1	: 0.0079	0.0079		
f2	: 0.9765	0.9768		
f3	: 0.0156	0.0153		
Ionic Strength	: 9.2116	8.0384		
pfm	: 0.0446	0.0419		
Carbonates*	: 2.5574	3.3053 mM/L	+0.1114	+29.24%
Calcium*	: 119.00	85.77 mg/L	-0.1422	-27.92%
Carbonic	: 1.25	1.63 mg/L	+0.1142	+30.08%
Bicarbonate	: 152.41	197.03 mg/L	+0.1115	+29.28%
Carbonate	: 2.40	3.04 mg/K	+0.1035	+26.90%
Alkalinity (as CaCO3)	: 130.52	167.77 mg/L		
Chloride*	: 19.00	19.81 mg/L	+0.0182	+4.28%
Magnesium*	: 4.00	3.90 mg/L	-0.0106	-2.41%
Sodium*	: 12.00	11.55 mg/L	-0.0168	-3.79%
Sulfate*	: 53.00	58.17 mg/L	+0.0404	+9.75%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.07636	Corresponding %	19.2237	
pHs	: 7.20	7.22		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 1.20	1.18	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 6.01	6.04	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHc	: 8.70	8.81		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.30	0.41	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: 43.33	104.33 mg/L as CaCO3		

K.15 Dublin 2

Target City: Dublin2 Base Water: Deionized
 Balancing pH 7.7755 is within acceptable bounds
 Net charge (imbalance) at this pH: 0.0000 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	1.24 mg/L
Calcium Sulfate Dihydrate	:	68.43 mg/L
Calcium Chloride Dihydrate	:	37.82 mg/L
Magnesium Sulfate Heptahydrate	:	40.51 mg/L
Calcium Carbonate	:	229.20 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	42.05 mg/L
Carbonic Acid	:	4.88 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Dublin2			
pH	: 7.78	7.78		
f1	: 0.0326	0.0326		
f2	: 0.9637	0.9637		
f3	: 0.0037	0.0037		
Ionic Strength	: 10.4121	10.4122		
pfm	: 0.0471	0.0471		
Carbonates*	: 5.2295	5.2305 mM/L	+0.0001	+0.02%
Calcium*	: 118.00	118.02 mg/L	+0.0001	+0.02%
Carbonic	: 10.56	10.56 mg/L	+0.0001	+0.02%
Bicarbonate	: 307.58	307.64 mg/L	+0.0001	+0.02%
Carbonate	: 1.17	1.17 mg/K	+0.0001	+0.02%
Alkalinity (as CaCO3)	: 254.19	254.24 mg/L		
Chloride*	: 19.00	18.99 mg/L	-0.0003	-0.06%
Magnesium*	: 4.00	3.99 mg/L	-0.0006	-0.13%
Sodium*	: 12.00	11.99 mg/L	-0.0003	-0.07%
Sulfate*	: 54.00	53.97 mg/L	-0.0003	-0.06%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.00031	Corresponding %	0.0706	
pHs	: 6.92	6.92		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 0.86	0.86	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 6.06	6.06	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 9.00	9.00		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	1.22	1.22	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: 167.72	167.76 mg/L as CaCO3		

K.16 Dublin 3

Target City: Dublin3 Base Water: Deionized
 Balancing pH 11.0786 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 3.1447 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	3.90 mg/L
Calcium Sulfate Dihydrate	:	80.46 mg/L
Calcium Chloride Dihydrate	:	39.43 mg/L
Magnesium Sulfate Heptahydrate	:	48.43 mg/L
Calcium Carbonate	:	120.69 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	35.88 mg/L
Carbonic Acid	:	2.36 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Dublin3			
pH	: 8.40	8.40		
f1	: 0.0079	0.0079		
f2	: 0.9765	0.9768		
f3	: 0.0156	0.0152		
Ionic Strength	: 9.1389	7.5954		
pfm	: 0.0444	0.0408		
Carbonates*	: 2.0492	2.8142 mM/L	+0.1378	+37.33%
Calcium*	: 120.00	77.81 mg/L	-0.1881	-35.16%
Carbonic	: 1.00	1.39 mg/L	+0.1415	+38.52%
Bicarbonate	: 122.13	167.77 mg/L	+0.1379	+37.38%
Carbonate	: 1.92	2.57 mg/K	+0.1271	+34.00%
Alkalinity (as CaCO3)	: 105.15	143.25 mg/L		
Chloride*	: 20.00	21.38 mg/L	+0.0290	+6.91%
Magnesium*	: 5.00	4.78 mg/L	-0.0200	-4.49%
Sodium*	: 12.00	11.35 mg/L	-0.0240	-5.39%
Sulfate*	: 55.00	63.77 mg/L	+0.0642	+15.94%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.10027	Corresponding %	25.9710	
pHs	: 7.30	7.33		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 1.10	1.07	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 6.19	6.26	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHc	: 8.60	8.74		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.20	0.34	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: 16.67	84.97 mg/L as CaCO3		

K.17 Dusseldorf

Target City: Dusseldorf Base Water: Deionized
 Balancing pH 8.5195 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 0.0099 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	30.10 mg/L
Calcium Sulfate Dihydrate	:	37.44 mg/L
Calcium Chloride Dihydrate	:	55.55 mg/L
Magnesium Sulfate Heptahydrate	:	152.00 mg/L
Calcium Carbonate	:	40.21 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	48.00 mg/L
Carbonic Acid	:	0.78 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET Dusseldorf	SYNTHESIS	pRatio	Pct Err
pH	8.40	8.40		
f1	0.0080	0.0080		
f2	0.9770	0.9770		
f3	0.0150	0.0150		
Ionic Strength	6.7723	6.7732		
pfm	0.0387	0.0387		
Carbonates*	1.3607	1.3625 mM/L	+0.0006	+0.14%
Calcium*	40.00	39.96 mg/L	-0.0004	-0.10%
Carbonic	0.67	0.68 mg/L	+0.0006	+0.14%
Bicarbonate	81.13	81.24 mg/L	+0.0006	+0.14%
Carbonate	1.22	1.23 mg/K	+0.0006	+0.14%
Alkalinity (as CaCO3)	70.72	70.82 mg/L		
Chloride*	45.00	45.05 mg/L	+0.0005	+0.11%
Magnesium*	15.00	14.99 mg/L	-0.0003	-0.08%
Sodium*	25.00	24.98 mg/L	-0.0004	-0.10%
Sulfate*	80.00	80.13 mg/L	+0.0007	+0.16%
Nitrate	0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.00050	Corresponding %	0.1155	
pHs	7.92	7.92		
Saturated WRT CaCO3?	Yes	Yes		
Langelier Index	0.48	0.48	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	7.44	7.44	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	8.43	8.43		
Saturated WRT CO2?	Yes	Yes		
CO2 Equilibrium Index:	0.03	0.03	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	33.39	33.52 mg/L as CaCO3		

K.18 Edinburgh 1

Target City: Edinburgh1 Base Water: Deionized
 Balancing pH 11.8362 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 10.1754 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	39.26 mg/L
Calcium Sulfate Dihydrate	:	20.47 mg/L
Calcium Chloride Dihydrate	:	34.56 mg/L
Magnesium Sulfate Heptahydrate	:	379.97 mg/L
Calcium Carbonate	:	158.86 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	145.84 mg/L
Carbonic Acid	:	3.08 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Edinburgh1			
pH	: 8.40	8.40		
f1	: 0.0076	0.0077		
f2	: 0.9752	0.9756		
f3	: 0.0172	0.0167		
Ionic Strength	: 17.3688	14.5548		
pfm	: 0.0592	0.0548		
Carbonates*	: 2.2951	4.8607 mM/L	+0.3259	+111.79%
Calcium*	: 141.00	77.80 mg/L	-0.2582	-44.82%
Carbonic	: 1.08	2.32 mg/L	+0.3305	+114.06%
Bicarbonate	: 136.59	289.41 mg/L	+0.3261	+111.88%
Carbonate	: 2.38	4.88 mg/K	+0.3128	+105.47%
Alkalinity (as CaCO3)	: 117.71	245.79 mg/L		
Chloride*	: 34.00	40.48 mg/L	+0.0758	+19.06%
Magnesium*	: 60.00	37.47 mg/L	-0.2045	-37.55%
Sodium*	: 80.00	55.36 mg/L	-0.1599	-30.81%
Sulfate*	: 96.00	159.51 mg/L	+0.2205	+66.16%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.22161	Corresponding %	66.5732	
pHs	: 7.25	7.16		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 1.15	1.24	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 6.10	5.92	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 8.63	8.96		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.23	0.56	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: -18.07	168.30 mg/L as CaCO3		

K.19 Edinburgh 2

Target City: Edinburgh2 Base Water: Deionized
 Balancing pH 10.6334 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 3.2343 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	33.64 mg/L
Calcium Sulfate Dihydrate	:	136.94 mg/L
Calcium Chloride Dihydrate	:	0.38 mg/L
Magnesium Sulfate Heptahydrate	:	231.01 mg/L
Calcium Carbonate	:	156.83 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	132.17 mg/L
Carbonic Acid	:	3.04 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Edinburgh2			
pH	: 8.40	8.40		
f1	: 0.0077	0.0077		
f2	: 0.9756	0.9757		
f3	: 0.0167	0.0166		
Ionic Strength	: 14.3304	13.8260		
pfm	: 0.0544	0.0535		
Carbonates*	: 3.6885	4.6623 mM/L	+0.1018	+26.40%
Calcium*	: 120.00	94.78 mg/L	-0.1024	-21.01%
Carbonic	: 1.76	2.23 mg/L	+0.1026	+26.66%
Bicarbonate	: 219.62	277.63 mg/L	+0.1018	+26.41%
Carbonate	: 3.69	4.64 mg/K	+0.0992	+25.66%
Alkalinity (as CaCO3)	: 187.22	235.84 mg/L		
Chloride*	: 20.00	20.59 mg/L	+0.0127	+2.97%
Magnesium*	: 25.00	22.78 mg/L	-0.0404	-8.88%
Sodium*	: 55.00	49.41 mg/L	-0.0466	-10.17%
Sulfate*	: 140.00	166.44 mg/L	+0.0751	+18.88%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.07124	Corresponding %	17.8269	
pHs	: 7.09	7.09		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 1.31	1.31	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 5.78	5.77	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 8.84	8.95		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.44	0.55	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: 86.98	154.88 mg/L as CaCO3		

K.20 Edinburgh 3

Target City: Edinburgh3 Base Water: Deionized
 Balancing pH 10.0591 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 1.2386 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	16.97 mg/L
Calcium Sulfate Dihydrate	:	81.36 mg/L
Calcium Chloride Dihydrate	:	76.04 mg/L
Magnesium Sulfate Heptahydrate	:	174.37 mg/L
Calcium Carbonate	:	117.81 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	46.71 mg/L
Carbonic Acid	:	2.30 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Edinburgh3			
pH	: 8.40	8.40		
f1	: 0.0078	0.0078		
f2	: 0.9762	0.9762		
f3	: 0.0160	0.0159		
Ionic Strength	: 11.0725	10.6737		
pfm	: 0.0485	0.0477		
Carbonates*	: 2.6230	2.8837 mM/L	+0.0412	+9.94%
Calcium*	: 100.00	86.85 mg/L	-0.0612	-13.15%
Carbonic	: 1.27	1.40 mg/L	+0.0420	+10.15%
Bicarbonate	: 156.26	171.81 mg/L	+0.0412	+9.95%
Carbonate	: 2.52	2.76 mg/K	+0.0388	+9.35%
Alkalinity (as CaCO3)	: 133.87	146.87 mg/L		
Chloride*	: 45.00	46.96 mg/L	+0.0186	+4.37%
Magnesium*	: 18.00	17.20 mg/L	-0.0199	-4.47%
Sodium*	: 20.00	19.46 mg/L	-0.0119	-2.71%
Sulfate*	: 105.00	113.36 mg/L	+0.0333	+7.96%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.03519	Corresponding %	8.4407	
pHs	: 7.29	7.30		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 1.11	1.10	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 6.18	6.21	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 8.70	8.74		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.30	0.34	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: 52.00	74.84 mg/L as CaCO3		

K.21 Edinburgh 4

Target City: Edinburgh4 Base Water: Deionized
 Balancing pH 10.1512 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 1.9644 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	54.53 mg/L
Calcium Sulfate Dihydrate	:	107.88 mg/L
Calcium Chloride Dihydrate	:	73.98 mg/L
Magnesium Sulfate Heptahydrate	:	239.67 mg/L
Calcium Carbonate	:	145.07 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	109.96 mg/L
Carbonic Acid	:	2.82 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Edinburgh4			
pH	: 8.40	8.40		
f1	: 0.0077	0.0077		
f2	: 0.9755	0.9756		
f3	: 0.0168	0.0167		
Ionic Strength	: 14.9651	14.5293		
pfm	: 0.0554	0.0547		
Carbonates*	: 3.6885	4.1667 mM/L	+0.0529	+12.96%
Calcium*	: 120.00	103.37 mg/L	-0.0648	-13.86%
Carbonic	: 1.76	1.99 mg/L	+0.0537	+13.16%
Bicarbonate	: 219.60	248.09 mg/L	+0.0530	+12.97%
Carbonate	: 3.72	4.18 mg/K	+0.0508	+12.41%
Alkalinity (as CaCO3)	: 187.25	211.11 mg/L		
Chloride*	: 65.00	68.76 mg/L	+0.0244	+5.78%
Magnesium*	: 25.00	23.63 mg/L	-0.0244	-5.46%
Sodium*	: 55.00	51.55 mg/L	-0.0282	-6.28%
Sulfate*	: 140.00	153.60 mg/L	+0.0403	+9.72%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.04204	Corresponding %	10.1641	
pHs	: 7.10	7.10		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 1.30	1.30	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 5.79	5.81	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 8.84	8.90		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.44	0.50	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: 87.01	123.53 mg/L as CaCO3		

K.22 Eeklo

Target City: Eeklo Base Water: Deionized
 Balancing pH 11.5369 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 7.9714 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	84.94 mg/L
Calcium Sulfate Dihydrate	:	0.02 mg/L
Calcium Chloride Dihydrate	:	48.87 mg/L
Magnesium Sulfate Heptahydrate	:	76.31 mg/L
Calcium Carbonate	:	213.04 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	200.80 mg/L
Carbonic Acid	:	4.13 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Eeklo			
pH	: 8.40	8.40		
f1	: 0.0077	0.0078		
f2	: 0.9755	0.9759		
f3	: 0.0168	0.0163		
Ionic Strength	: 14.9191	12.5189		
pfm	: 0.0554	0.0512		
Carbonates*	: 4.1803	6.5844 mM/L	+0.1973	+57.51%
Calcium*	: 138.00	98.64 mg/L	-0.1458	-28.52%
Carbonic	: 1.99	3.17 mg/L	+0.2016	+59.09%
Bicarbonate	: 248.88	392.17 mg/L	+0.1975	+57.57%
Carbonate	: 4.21	6.45 mg/K	+0.1850	+53.11%
Alkalinity (as CaCO3)	: 211.82	331.75 mg/L		
Chloride*	: 65.00	75.09 mg/L	+0.0627	+15.53%
Magnesium*	: 28.00	7.53 mg/L	-0.5706	-73.12%
Sodium*	: 115.00	88.37 mg/L	-0.1144	-23.16%
Sulfate*	: 8.00	29.75 mg/L	+0.5704	+271.89%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.34838	Corresponding %	123.0404	
pHs	: 6.98	6.91		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 1.42	1.49	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 5.56	5.42	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 8.90	9.10		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.50	0.70	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: 96.98	257.01 mg/L as CaCO3		

K.23 Eeklo Using MgCO₃

Target City: Eeklo Base Water: Deionized
 Balancing pH 11.5369 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 7.9714 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	82.59 mg/L
Calcium Sulfate Dihydrate	:	13.85 mg/L
Calcium Chloride Dihydrate	:	56.74 mg/L
Magnesium Sulfate Heptahydrate	:	0.97 mg/L
Calcium Carbonate	:	189.30 mg/L
Magnesium Carbonate	:	82.65 mg/L
Sodium Bicarbonate	:	192.82 mg/L
Carbonic Acid	:	5.59 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Eeklo			
pH	: 8.40	8.40		
f1	: 0.0077	0.0077		
f2	: 0.9755	0.9757		
f3	: 0.0168	0.0166		
Ionic Strength	: 14.9191	13.8831		
pfm	: 0.0554	0.0536		
Carbonates*	: 4.1803	7.9625 mM/L	+0.2798	+90.47%
Calcium*	: 138.00	94.50 mg/L	-0.1645	-31.52%
Carbonic	: 1.99	3.81 mg/L	+0.2817	+91.27%
Bicarbonate	: 248.88	474.14 mg/L	+0.2799	+90.51%
Carbonate	: 4.21	7.93 mg/K	+0.2747	+88.23%
Alkalinity (as CaCO ₃)	: 211.82	400.69 mg/L		
Chloride*	: 65.00	77.47 mg/L	+0.0762	+19.18%
Magnesium*	: 28.00	23.92 mg/L	-0.0684	-14.58%
Sodium*	: 115.00	85.26 mg/L	-0.1300	-25.86%
Sulfate*	: 8.00	8.11 mg/L	+0.0057	+1.33%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.14876	Corresponding %	40.8499	
pHs	: 6.98	6.86		
Saturated WRT CaCO ₃ ?	: Yes	Yes		
Langelier Index	: 1.42	1.54	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 5.56	5.31	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 8.90	9.18		
Saturated WRT CO ₂ ?	: Yes	Yes		
CO ₂ Equilibrium Index:	0.50	0.78	EI < 0 ~ Gains CO ₂ ; EI > 0 ~ Loses CO ₂	
Residual Alkalinity	: 96.98	319.27 mg/L as CaCO ₃		

K.24 Fairfax County

Target City: FairfaxCo Base Water: Deionized
 Balancing pH 10.1138 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 0.7840 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	14.55 mg/L
Calcium Sulfate Dihydrate	:	0.00 mg/L
Calcium Chloride Dihydrate	:	34.11 mg/L
Magnesium Sulfate Heptahydrate	:	122.84 mg/L
Calcium Carbonate	:	60.88 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	22.69 mg/L
Carbonic Acid	:	1.19 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET FairfaxCo	SYNTHESIS	pRatio	Pct Err
pH	: 8.40	8.40		
f1	: 0.0081	0.0081		
f2	: 0.9774	0.9774		
f3	: 0.0146	0.0145		
Ionic Strength	: 5.2807	5.0466		
pfm	: 0.0345	0.0338		
Carbonates*	: 1.4905	1.4743 mM/L	-0.0047	-1.09%
Calcium*	: 33.26	33.68 mg/L	+0.0054	+1.26%
Carbonic	: 0.75	0.74 mg/L	-0.0040	-0.92%
Bicarbonate	: 88.91	87.94 mg/L	-0.0047	-1.08%
Carbonate	: 1.30	1.28 mg/K	-0.0069	-1.57%
Alkalinity (as CaCO3)	: 77.14	76.32 mg/L		
Chloride*	: 25.40	25.28 mg/L	-0.0021	-0.48%
Magnesium*	: 18.90	12.11 mg/L	-0.1932	-35.91%
Sodium*	: 11.90	11.94 mg/L	+0.0013	+0.30%
Sulfate*	: 30.70	47.88 mg/L	+0.1930	+55.95%
Nitrate	: 5.58	0.00 mg/L		
RMS Log Error (Items with *):	0.11152	Corresponding %	29.2770	
pHs	: 7.94	7.94		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 0.46	0.46	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 7.48	7.47	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 8.47	8.47		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.07	0.07	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: 42.32	45.19 mg/L as CaCO3		

K.25 Fairfax County - Using MgCO₃

Target City: FairfaxCo Base Water: Deionized
 Balancing pH 10.1138 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 0.7840 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	15.08 mg/L
Calcium Sulfate Dihydrate	:	10.05 mg/L
Calcium Chloride Dihydrate	:	38.16 mg/L
Magnesium Sulfate Heptahydrate	:	70.18 mg/L
Calcium Carbonate	:	39.75 mg/L
Magnesium Carbonate	:	32.99 mg/L
Sodium Bicarbonate	:	19.65 mg/L
Carbonic Acid	:	1.55 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET FairfaxCo	SYNTHESIS	pRatio	Pct Err
pH	: 8.40	8.40		
f1	: 0.0081	0.0081		
f2	: 0.9774	0.9774		
f3	: 0.0146	0.0145		
Ionic Strength	: 5.2807	5.0244		
pfm	: 0.0345	0.0337		
Carbonates*	: 1.4905	1.7963 mM/L	+0.0810	+20.51%
Calcium*	: 33.26	28.66 mg/L	-0.0646	-13.82%
Carbonic	: 0.75	0.90 mg/L	+0.0819	+20.74%
Bicarbonate	: 88.91	107.15 mg/L	+0.0811	+20.52%
Carbonate	: 1.30	1.56 mg/K	+0.0787	+19.87%
Alkalinity (as CaCO ₃)	: 77.14	92.36 mg/L		
Chloride*	: 25.40	27.55 mg/L	+0.0353	+8.48%
Magnesium*	: 18.90	16.43 mg/L	-0.0609	-13.08%
Sodium*	: 11.90	11.31 mg/L	-0.0220	-4.94%
Sulfate*	: 30.70	32.96 mg/L	+0.0309	+7.37%
Nitrate	: 5.58	0.00 mg/L		
RMS Log Error (Items with *):	0.05343	Corresponding %	13.0926	
pHs	: 7.94	7.92		
Saturated WRT CaCO ₃ ?	: Yes	Yes		
Langelier Index	: 0.46	0.48	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 7.48	7.44	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 8.47	8.55		
Saturated WRT CO ₂ ?	: Yes	Yes		
CO ₂ Equilibrium Index:	0.07	0.15	EI < 0 ~ Gains CO ₂ ; EI > 0 ~ Loses CO ₂	
Residual Alkalinity	: 42.32	62.27 mg/L as CaCO ₃		

K.26 Ghent

Target City: Ghent Base Water: Deionized
 Balancing pH 8.6235 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 0.0706 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	0.87 mg/L
Calcium Sulfate Dihydrate	:	30.60 mg/L
Calcium Chloride Dihydrate	:	77.78 mg/L
Magnesium Sulfate Heptahydrate	:	172.10 mg/L
Calcium Carbonate	:	212.17 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	64.48 mg/L
Carbonic Acid	:	4.15 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Ghent			
pH	: 8.40	8.40		
f1	: 0.0078	0.0078		
f2	: 0.9760	0.9760		
f3	: 0.0163	0.0163		
Ionic Strength	: 12.2949	12.2744		
pfm	: 0.0508	0.0507		
Carbonates*	: 4.9344	4.9620 mM/L	+0.0024	+0.56%
Calcium*	: 114.00	113.29 mg/L	-0.0027	-0.62%
Carbonic	: 2.38	2.39 mg/L	+0.0025	+0.57%
Bicarbonate	: 293.91	295.55 mg/L	+0.0024	+0.56%
Carbonate	: 4.82	4.85 mg/K	+0.0023	+0.53%
Alkalinity (as CaCO3)	: 249.34	250.71 mg/L		
Chloride*	: 38.00	38.03 mg/L	+0.0004	+0.09%
Magnesium*	: 17.00	16.97 mg/L	-0.0007	-0.17%
Sodium*	: 18.00	17.98 mg/L	-0.0004	-0.08%
Sulfate*	: 84.00	84.15 mg/L	+0.0008	+0.17%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.00156	Corresponding %	0.3603	
pHs	: 6.97	6.97		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 1.43	1.43	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 5.54	5.54	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 8.97	8.98		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.57	0.58	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: 158.07	159.97 mg/L as CaCO3		

K.27 Hamilton, MI

Target City: Hamilton_M Base Water: Deionized
 Balancing pH 6.7446 is within acceptable bounds
 Net charge (imbalance) at this pH: 0.0000 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	1.17 mg/L
Calcium Sulfate Dihydrate	:	0.00 mg/L
Calcium Chloride Dihydrate	:	0.10 mg/L
Magnesium Sulfate Heptahydrate	:	2.72 mg/L
Calcium Carbonate	:	27.84 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	41.85 mg/L
Carbonic Acid	:	1.37 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Hamilton_MF			
pH	: 6.74	6.74		
f1	: 0.2786	0.2793		
f2	: 0.7212	0.7205		
f3	: 0.0002	0.0002		
Ionic Strength	: 1.6172	1.3924		
pfm	: 0.0197	0.0183		
Carbonates*	: 1.6885	1.4614 mM/L	-0.0627	-13.45%
Calcium*	: 10.40	11.17 mg/L	+0.0312	+7.45%
Carbonic	: 29.18	25.32 mg/L	-0.0617	-13.25%
Bicarbonate	: 74.32	64.27 mg/L	-0.0631	-13.52%
Carbonate	: 0.02	0.02 mg/K	-0.0672	-14.34%
Alkalinity (as CaCO3)	: 62.74	54.60 mg/L		
Chloride*	: 0.75	0.76 mg/L	+0.0048	+1.12%
Magnesium*	: 2.90	0.27 mg/L	-1.0333	-90.74%
Sodium*	: 11.20	11.91 mg/L	+0.0268	+6.37%
Sulfate*	: 0.10	1.06 mg/L	+1.0260	+961.63%
Nitrate	: 0.20	0.00 mg/L		
RMS Log Error (Items with *):	0.59525	Corresponding %	293.7750	
pHs	: 8.45	8.48		
Saturated WRT CaCO3?	: No	No		
Langelier Index	: -1.71	-1.73	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 10.16	10.21	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 8.41	8.35		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	1.66	1.60	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: 53.62	46.48 mg/L as CaCO3		

K.28 Hamilton, MI Using MgCO₃

Target City: Hamilton_M Base Water: Deionized
 Balancing pH 6.7446 is within acceptable bounds
 Net charge (imbalance) at this pH: 0.0000 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	1.25 mg/L
Calcium Sulfate Dihydrate	:	0.04 mg/L
Calcium Chloride Dihydrate	:	0.00 mg/L
Magnesium Sulfate Heptahydrate	:	0.18 mg/L
Calcium Carbonate	:	25.91 mg/L
Magnesium Carbonate	:	10.32 mg/L
Sodium Bicarbonate	:	31.98 mg/L
Carbonic Acid	:	1.65 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Hamilton_MF			
pH	: 6.74	6.74		
f1	: 0.2786	0.2788		
f2	: 0.7212	0.7210		
f3	: 0.0002	0.0002		
Ionic Strength	: 1.6172	1.5429		
pfm	: 0.0197	0.0193		
Carbonates*	: 1.6885	1.5844 mM/L	-0.0276	-6.17%
Calcium*	: 10.40	10.38 mg/L	-0.0006	-0.15%
Carbonic	: 29.18	27.40 mg/L	-0.0273	-6.10%
Bicarbonate	: 74.32	69.71 mg/L	-0.0278	-6.19%
Carbonate	: 0.02	0.02 mg/K	-0.0291	-6.48%
Alkalinity (as CaCO ₃)	: 62.74	59.02 mg/L		
Chloride*	: 0.75	0.76 mg/L	+0.0064	+1.49%
Magnesium*	: 2.90	2.99 mg/L	+0.0137	+3.20%
Sodium*	: 11.20	9.24 mg/L	-0.0833	-17.46%
Sulfate*	: 0.10	0.09 mg/L	-0.0229	-5.13%
Nitrate	: 0.20	0.00 mg/L		
RMS Log Error (Items with *)	: 0.03755	Corresponding %	9.0301	
pHs	: 8.45	8.48		
Saturated WRT CaCO ₃ ?	: No	No		
Langelier Index	: -1.71	-1.73	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 10.16	10.21	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pH _e	: 8.41	8.38		
Saturated WRT CO ₂ ?	: Yes	Yes		
CO ₂ Equilibrium Index:	: 1.66	1.64	EI < 0 ~ Gains CO ₂ ; EI > 0 ~ Loses CO ₂	
Residual Alkalinity	: 53.62	49.85 mg/L as CaCO ₃		

K.29 Koln

Target City: Koln Base Water: Deionized
 Balancing pH 10.1241 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 1.3050 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	72.06 mg/L
Calcium Sulfate Dihydrate	:	58.98 mg/L
Calcium Chloride Dihydrate	:	156.10 mg/L
Magnesium Sulfate Heptahydrate	:	147.39 mg/L
Calcium Carbonate	:	89.83 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	76.04 mg/L
Carbonic Acid	:	1.74 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Koln			
pH	: 8.40	8.40		
f1	: 0.0078	0.0078		
f2	: 0.9760	0.9760		
f3	: 0.0163	0.0162		
Ionic Strength	: 12.1610	11.8000		
pfm	: 0.0505	0.0499		
Carbonates*	: 2.4918	2.6745 mM/L	+0.0307	+7.33%
Calcium*	: 104.00	92.26 mg/L	-0.0520	-11.29%
Carbonic	: 1.20	1.29 mg/L	+0.0314	+7.51%
Bicarbonate	: 148.42	159.31 mg/L	+0.0308	+7.34%
Carbonate	: 2.43	2.60 mg/K	+0.0287	+6.84%
Alkalinity (as CaCO3)	: 127.36	136.47 mg/L		
Chloride*	: 109.00	118.99 mg/L	+0.0381	+9.17%
Magnesium*	: 15.00	14.53 mg/L	-0.0137	-3.11%
Sodium*	: 52.00	49.16 mg/L	-0.0244	-5.47%
Sulfate*	: 86.00	90.35 mg/L	+0.0214	+5.06%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.03252	Corresponding %	7.7762	
pHs	: 7.30	7.32		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 1.10	1.08	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 6.21	6.24	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 8.68	8.71		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.28	0.31	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: 44.41	62.16 mg/L as CaCO3		

K.30 London 1

Target City: London1 Base Water: Deionized
 Balancing pH 11.0667 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 3.5551 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	28.91 mg/L
Calcium Sulfate Dihydrate	:	69.55 mg/L
Calcium Chloride Dihydrate	:	0.84 mg/L
Magnesium Sulfate Heptahydrate	:	143.58 mg/L
Calcium Carbonate	:	63.31 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	219.40 mg/L
Carbonic Acid	:	1.20 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	London1			
pH	: 8.40	8.40		
f1	: 0.0079	0.0079		
f2	: 0.9765	0.9766		
f3	: 0.0156	0.0156		
Ionic Strength	: 9.2192	9.0005		
pfm	: 0.0446	0.0441		
Carbonates*	: 2.5574	3.8441 mM/L	+0.1770	+50.31%
Calcium*	: 52.00	41.77 mg/L	-0.0951	-19.67%
Carbonic	: 1.25	1.88 mg/L	+0.1775	+50.49%
Bicarbonate	: 152.41	229.11 mg/L	+0.1770	+50.32%
Carbonate	: 2.40	3.59 mg/K	+0.1756	+49.82%
Alkalinity (as CaCO3)	: 130.52	194.71 mg/L		
Chloride*	: 17.00	17.94 mg/L	+0.0235	+5.55%
Magnesium*	: 16.00	14.16 mg/L	-0.0531	-11.51%
Sodium*	: 99.00	71.41 mg/L	-0.1418	-27.86%
Sulfate*	: 77.00	94.77 mg/L	+0.0902	+23.07%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.10954	Corresponding %	28.6894	
pHs	: 7.56	7.48		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 0.84	0.92	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 6.73	6.56	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 8.70	8.87		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.30	0.47	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: 84.04	156.61 mg/L as CaCO3		

K.31 London2

Target City: London2 Base Water: Deionized
 Balancing pH 10.6957 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 2.0915 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	1.65 mg/L
Calcium Sulfate Dihydrate	:	44.72 mg/L
Calcium Chloride Dihydrate	:	42.04 mg/L
Magnesium Sulfate Heptahydrate	:	48.67 mg/L
Calcium Carbonate	:	107.10 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	49.15 mg/L
Carbonic Acid	:	2.10 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	London2			
pH	: 8.40	8.40		
f1	: 0.0080	0.0080		
f2	: 0.9769	0.9771		
f3	: 0.0152	0.0149		
Ionic Strength	: 7.3948	6.5339		
pfm	: 0.0403	0.0381		
Carbonates*	: 2.0492	2.7029 mM/L	+0.1203	+31.90%
Calcium*	: 90.00	64.76 mg/L	-0.1429	-28.05%
Carbonic	: 1.01	1.34 mg/L	+0.1226	+32.61%
Bicarbonate	: 122.17	161.18 mg/L	+0.1203	+31.93%
Carbonate	: 1.86	2.42 mg/K	+0.1136	+29.91%
Alkalinity (as CaCO3)	: 105.08	137.64 mg/L		
Chloride*	: 20.00	21.27 mg/L	+0.0268	+6.37%
Magnesium*	: 5.00	4.80 mg/L	-0.0178	-4.02%
Sodium*	: 15.00	14.10 mg/L	-0.0269	-6.00%
Sulfate*	: 40.00	43.92 mg/L	+0.0406	+9.80%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.07990	Corresponding %	20.1979	
pHs	: 7.40	7.41		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 1.00	0.99	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 6.40	6.42	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 8.60	8.73		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.20	0.33	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: 37.98	88.66 mg/L as CaCO3		

K.32 London City

Target City: LondonCty Base Water: Deionized
 Balancing pH 11.3643 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 3.8037 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	6.78 mg/L
Calcium Sulfate Dihydrate	:	11.97 mg/L
Calcium Chloride Dihydrate	:	13.94 mg/L
Magnesium Sulfate Heptahydrate	:	54.38 mg/L
Calcium Carbonate	:	104.20 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	56.08 mg/L
Carbonic Acid	:	2.04 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET LondonCty	SYNTHESIS	pRatio	Pct Err
pH	: 8.40	8.40		
f1	: 0.0080	0.0081		
f2	: 0.9770	0.9773		
f3	: 0.0150	0.0146		
Ionic Strength	: 6.7936	5.3758		
pfm	: 0.0388	0.0348		
Carbonates*	: 1.3443	2.7276 mM/L	+0.3073	+102.91%
Calcium*	: 90.00	48.31 mg/L	-0.2702	-46.32%
Carbonic	: 0.67	1.36 mg/L	+0.3114	+104.84%
Bicarbonate	: 80.15	162.69 mg/L	+0.3074	+102.97%
Carbonate	: 1.21	2.39 mg/K	+0.2955	+97.47%
Alkalinity (as CaCO3)	: 69.91	138.81 mg/L		
Chloride*	: 10.00	10.83 mg/L	+0.0347	+8.31%
Magnesium*	: 6.00	5.36 mg/L	-0.0488	-10.62%
Sodium*	: 22.00	18.01 mg/L	-0.0869	-18.13%
Sulfate*	: 24.00	27.87 mg/L	+0.0650	+16.14%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.17454	Corresponding %	49.4665	
pHs	: 7.58	7.52		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 0.82	0.88	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 6.75	6.64	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 8.42	8.73		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.02	0.33	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: 2.22	101.21 mg/L as CaCO3		

K.33 London Well

Target City: LondonWell Base Water: Deionized
 Balancing pH 11.5529 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 5.6227 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	55.64 mg/L
Calcium Sulfate Dihydrate	:	0.00 mg/L
Calcium Chloride Dihydrate	:	18.32 mg/L
Magnesium Sulfate Heptahydrate	:	163.30 mg/L
Calcium Carbonate	:	79.54 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	120.80 mg/L
Carbonic Acid	:	1.54 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET LondonWell	SYNTHESIS	pRatio	Pct Err
pH	: 8.40	8.40		
f1	: 0.0079	0.0079		
f2	: 0.9765	0.9768		
f3	: 0.0156	0.0153		
Ionic Strength	: 9.1187	7.8241		
pfm	: 0.0444	0.0414		
Carbonates*	: 1.7049	3.0015 mM/L	+0.2456	+76.05%
Calcium*	: 52.00	36.85 mg/L	-0.1496	-29.14%
Carbonic	: 0.83	1.48 mg/L	+0.2487	+77.31%
Bicarbonate	: 101.61	178.93 mg/L	+0.2458	+76.10%
Carbonate	: 1.59	2.75 mg/K	+0.2368	+72.49%
Alkalinity (as CaCO3)	: 87.98	152.61 mg/L		
Chloride*	: 34.00	42.59 mg/L	+0.0978	+25.26%
Magnesium*	: 32.00	16.10 mg/L	-0.2982	-49.68%
Sodium*	: 86.00	54.95 mg/L	-0.1945	-36.11%
Sulfate*	: 32.00	63.65 mg/L	+0.2986	+98.89%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.22666	Corresponding %	68.5228	
pHs	: 7.74	7.63		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 0.66	0.77	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 7.08	6.85	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 8.52	8.77		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.12	0.37	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: 32.10	116.87 mg/L as CaCO3		

K.34 London Well Using MgCO₃

Target City: LondonWell Base Water: Deionized
 Balancing pH 11.5529 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 5.6227 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	60.87 mg/L
Calcium Sulfate Dihydrate	:	30.40 mg/L
Calcium Chloride Dihydrate	:	14.92 mg/L
Magnesium Sulfate Heptahydrate	:	53.25 mg/L
Calcium Carbonate	:	61.42 mg/L
Magnesium Carbonate	:	57.87 mg/L
Sodium Bicarbonate	:	106.25 mg/L
Carbonic Acid	:	2.54 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET LondonWell	SYNTHESIS	pRatio	Pct Err
pH	: 8.40	8.40		
f1	: 0.0079	0.0079		
f2	: 0.9765	0.9767		
f3	: 0.0156	0.0153		
Ionic Strength	: 9.1187	8.1142		
pfm	: 0.0444	0.0421		
Carbonates*	: 1.7049	3.8322 mM/L	+0.3517	+124.77%
Calcium*	: 52.00	35.74 mg/L	-0.1629	-31.27%
Carbonic	: 0.83	1.88 mg/L	+0.3541	+126.01%
Bicarbonate	: 101.61	228.44 mg/L	+0.3518	+124.82%
Carbonate	: 1.59	3.53 mg/K	+0.3449	+121.28%
Alkalinity (as CaCO ₃)	: 87.98	194.06 mg/L		
Chloride*	: 34.00	44.12 mg/L	+0.1131	+29.76%
Magnesium*	: 32.00	21.93 mg/L	-0.1641	-31.47%
Sodium*	: 86.00	53.02 mg/L	-0.2101	-38.35%
Sulfate*	: 32.00	37.72 mg/L	+0.0714	+17.86%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *)	: 0.19966	Corresponding %	58.3656	
pHs	: 7.74	7.54		
Saturated WRT CaCO ₃ ?	: Yes	Yes		
Langelier Index	: 0.66	0.86	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 7.08	6.68	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 8.52	8.87		
Saturated WRT CO ₂ ?	: Yes	Yes		
CO ₂ Equilibrium Index:	: 0.12	0.47	EI < 0 ~ Gains CO ₂ ; EI > 0 ~ Loses CO ₂	
Residual Alkalinity	: 32.10	155.69 mg/L as CaCO ₃		

K.35 Luik

Target City: Luik Base Water: Deionized
 Balancing pH 11.3035 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 4.3120 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	130.19 mg/L
Calcium Sulfate Dihydrate	:	0.00 mg/L
Calcium Chloride Dihydrate	:	226.82 mg/L
Magnesium Sulfate Heptahydrate	:	71.42 mg/L
Calcium Carbonate	:	43.88 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	139.56 mg/L
Carbonic Acid	:	0.83 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Luik			
pH	: 8.40	8.40		
f1	: 0.0078	0.0078		
f2	: 0.9760	0.9762		
f3	: 0.0162	0.0160		
Ionic Strength	: 11.8558	11.0123		
pfm	: 0.0500	0.0483		
Carbonates*	: 2.1967	2.5140 mM/L	+0.0586	+14.44%
Calcium*	: 98.00	79.41 mg/L	-0.0914	-18.97%
Carbonic	: 1.06	1.22 mg/L	+0.0603	+14.89%
Bicarbonate	: 130.85	149.78 mg/L	+0.0587	+14.46%
Carbonate	: 2.13	2.42 mg/K	+0.0538	+13.18%
Alkalinity (as CaCO3)	: 112.62	128.43 mg/L		
Chloride*	: 142.00	188.36 mg/L	+0.1227	+32.65%
Magnesium*	: 14.00	7.04 mg/L	-0.2984	-49.70%
Sodium*	: 110.00	89.41 mg/L	-0.0900	-18.72%
Sulfate*	: 14.00	27.84 mg/L	+0.2985	+98.83%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.18845	Corresponding %	54.3283	
pHs	: 7.38	7.41		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 1.02	0.99	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 6.36	6.41	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 8.62	8.68		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.22	0.28	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: 34.53	67.68 mg/L as CaCO3		

K.36 Luik Using MgCO₃

Target City: Luik Base Water: Deionized
 Balancing pH 11.3035 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 4.3120 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	136.31 mg/L
Calcium Sulfate Dihydrate	:	2.04 mg/L
Calcium Chloride Dihydrate	:	252.56 mg/L
Magnesium Sulfate Heptahydrate	:	33.66 mg/L
Calcium Carbonate	:	18.83 mg/L
Magnesium Carbonate	:	33.85 mg/L
Sodium Bicarbonate	:	120.78 mg/L
Carbonic Acid	:	1.13 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Luik			
pH	: 8.40	8.40		
f1	: 0.0078	0.0078		
f2	: 0.9760	0.9761		
f3	: 0.0162	0.0161		
Ionic Strength	: 11.8558	11.3076		
pfm	: 0.0500	0.0489		
Carbonates*	: 2.1967	2.5922 mM/L	+0.0719	+18.00%
Calcium*	: 98.00	76.87 mg/L	-0.1055	-21.56%
Carbonic	: 1.06	1.25 mg/L	+0.0730	+18.30%
Bicarbonate	: 130.85	154.43 mg/L	+0.0719	+18.02%
Carbonate	: 2.13	2.50 mg/K	+0.0688	+17.16%
Alkalinity (as CaCO ₃)	: 112.62	132.34 mg/L		
Chloride*	: 142.00	204.48 mg/L	+0.1584	+44.00%
Magnesium*	: 14.00	13.08 mg/L	-0.0296	-6.60%
Sodium*	: 110.00	86.68 mg/L	-0.1035	-21.20%
Sulfate*	: 14.00	14.26 mg/L	+0.0080	+1.85%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.09401	Corresponding %	24.1685	
pHs	: 7.38	7.41		
Saturated WRT CaCO ₃ ?	: Yes	Yes		
Langelier Index	: 1.02	0.99	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 6.36	6.42	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 8.62	8.70		
Saturated WRT CO ₂ ?	: Yes	Yes		
CO ₂ Equilibrium Index:	0.22	0.30	EI < 0 ~ Gains CO ₂ ; EI > 0 ~ Loses CO ₂	
Residual Alkalinity	: 34.53	69.86 mg/L as CaCO ₃		

K.37 Munich 1

Target City: Munich1 Base Water: Deionized
 Balancing pH 10.8604 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 2.6994 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	0.15 mg/L
Calcium Sulfate Dihydrate	:	0.00 mg/L
Calcium Chloride Dihydrate	:	3.99 mg/L
Magnesium Sulfate Heptahydrate	:	68.42 mg/L
Calcium Carbonate	:	144.86 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	7.07 mg/L
Carbonic Acid	:	2.85 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Munich1			
pH	8.40	8.40		
f1	0.0080	0.0080		
f2	0.9770	0.9773		
f3	0.0150	0.0147		
Ionic Strength	6.6977	5.6469		
pfm	0.0385	0.0356		
Carbonates*	2.3279	2.9552 mM/L	+0.1036	+26.95%
Calcium*	75.00	59.09 mg/L	-0.1035	-21.21%
Carbonic	1.15	1.48 mg/L	+0.1067	+27.84%
Bicarbonate	138.81	176.26 mg/L	+0.1037	+26.98%
Carbonate	2.09	2.60 mg/K	+0.0950	+24.44%
Alkalinity (as CaCO3)	118.95	150.17 mg/L		
Chloride*	2.00	2.02 mg/L	+0.0040	+0.93%
Magnesium*	18.00	6.75 mg/L	-0.4261	-62.52%
Sodium*	2.00	1.99 mg/L	-0.0013	-0.31%
Sulfate*	10.00	26.67 mg/L	+0.4260	+166.67%
Nitrate	0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.25316	Corresponding %	79.1248	
pHs	7.41	7.40		
Saturated WRT CaCO3?	Yes	Yes		
Langelier Index	0.99	1.00	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	6.43	6.40	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	8.66	8.77		
Saturated WRT CO2?	Yes	Yes		
CO2 Equilibrium Index:	0.26	0.37	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	54.90	104.08 mg/L as CaCO3		

K.38 Munich 1 Using MgCO₃

Target City: Munich1 Base Water: Deionized
 Balancing pH 10.8604 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 2.6994 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	0.79 mg/L
Calcium Sulfate Dihydrate	:	18.20 mg/L
Calcium Chloride Dihydrate	:	3.18 mg/L
Magnesium Sulfate Heptahydrate	:	0.20 mg/L
Calcium Carbonate	:	121.13 mg/L
Magnesium Carbonate	:	53.24 mg/L
Sodium Bicarbonate	:	6.10 mg/L
Carbonic Acid	:	3.63 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Munich1			
pH	: 8.40	8.40		
f1	: 0.0080	0.0080		
f2	: 0.9770	0.9772		
f3	: 0.0150	0.0148		
Ionic Strength	: 6.6977	6.1353		
pfm	: 0.0385	0.0370		
Carbonates*	: 2.3279	3.7268 mM/L	+0.2044	+60.10%
Calcium*	: 75.00	53.61 mg/L	-0.1458	-28.52%
Carbonic	: 1.15	1.85 mg/L	+0.2060	+60.68%
Bicarbonate	: 138.81	222.25 mg/L	+0.2044	+60.12%
Carbonate	: 2.09	3.32 mg/K	+0.1999	+58.43%
Alkalinity (as CaCO ₃)	: 118.95	188.67 mg/L		
Chloride*	: 2.00	2.01 mg/L	+0.0027	+0.62%
Magnesium*	: 18.00	15.36 mg/L	-0.0688	-14.65%
Sodium*	: 2.00	1.98 mg/L	-0.0046	-1.05%
Sulfate*	: 10.00	10.23 mg/L	+0.0100	+2.33%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *)	: 0.10638	Corresponding %	27.7546	
pHs	: 7.41	7.35		
Saturated WRT CaCO ₃ ?	: Yes	Yes		
Langelier Index	: 0.99	1.05	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 6.43	6.30	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pH _e	: 8.66	8.87		
Saturated WRT CO ₂ ?	: Yes	Yes		
CO ₂ Equilibrium Index:	: 0.26	0.47	EI < 0 ~ Gains CO ₂ ; EI > 0 ~ Loses CO ₂	
Residual Alkalinity	: 54.90	141.43 mg/L as CaCO ₃		

K.39 Munich 2

Target City: Munich2 Base Water: Deionized
 Balancing pH 9.8255 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 0.9102 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	1.37 mg/L
Calcium Sulfate Dihydrate	:	15.22 mg/L
Calcium Chloride Dihydrate	:	76.56 mg/L
Magnesium Sulfate Heptahydrate	:	197.94 mg/L
Calcium Carbonate	:	161.21 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	5.32 mg/L
Carbonic Acid	:	3.16 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Munich2			
pH	: 8.40	8.40		
f1	: 0.0078	0.0078		
f2	: 0.9761	0.9764		
f3	: 0.0161	0.0158		
Ionic Strength	: 11.2286	10.0741		
pfm	: 0.0488	0.0464		
Carbonates*	: 2.8033	3.2548 mM/L	+0.0649	+16.11%
Calcium*	: 109.00	88.97 mg/L	-0.0882	-18.38%
Carbonic	: 1.36	1.58 mg/L	+0.0673	+16.76%
Bicarbonate	: 167.00	193.94 mg/L	+0.0649	+16.13%
Carbonate	: 2.70	3.09 mg/K	+0.0580	+14.28%
Alkalinity (as CaCO3)	: 142.88	165.36 mg/L		
Chloride*	: 36.00	37.75 mg/L	+0.0206	+4.87%
Magnesium*	: 21.00	19.52 mg/L	-0.0317	-7.05%
Sodium*	: 2.00	1.99 mg/L	-0.0014	-0.31%
Sulfate*	: 79.00	85.64 mg/L	+0.0350	+8.40%
Nitrate	: 53.00	0.00 mg/L		
RMS Log Error (Items with *):	0.04941	Corresponding %	12.0494	
pHs	: 7.22	7.23		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 1.18	1.17	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 6.05	6.07	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHc	: 8.73	8.80		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.33	0.40	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: 52.83	90.46 mg/L as CaCO3		

K.40 Munich_3

Target City: Munich3 Base Water: Deionized
 Balancing pH 10.7625 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 2.5841 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	0.37 mg/L
Calcium Sulfate Dihydrate	:	0.00 mg/L
Calcium Chloride Dihydrate	:	3.71 mg/L
Magnesium Sulfate Heptahydrate	:	68.47 mg/L
Calcium Carbonate	:	151.46 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	6.73 mg/L
Carbonic Acid	:	2.98 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Munich3			
pH	8.40	8.40		
f1	0.0080	0.0080		
f2	0.9770	0.9772		
f3	0.0150	0.0147		
Ionic Strength	6.8317	5.8406		
pfm	0.0389	0.0362		
Carbonates*	2.4918	3.0821 mM/L	+0.0923	+23.69%
Calcium*	76.00	61.66 mg/L	-0.0908	-18.87%
Carbonic	1.23	1.54 mg/L	+0.0951	+24.49%
Bicarbonate	148.58	183.82 mg/L	+0.0924	+23.72%
Carbonate	2.25	2.73 mg/K	+0.0843	+21.42%
Alkalinity (as CaCO3)	127.13	156.51 mg/L		
Chloride*	2.00	2.01 mg/L	+0.0032	+0.73%
Magnesium*	18.00	6.75 mg/L	-0.4259	-62.49%
Sodium*	2.00	1.99 mg/L	-0.0023	-0.54%
Sulfate*	10.00	26.68 mg/L	+0.4263	+166.85%
Nitrate	0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.25161	Corresponding %	78.4878	
pHs	7.38	7.37		
Saturated WRT CaCO3?	Yes	Yes		
Langelier Index	1.02	1.03	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	6.36	6.33	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHc	8.69	8.79		
Saturated WRT CO2?	Yes	Yes		
CO2 Equilibrium Index:	0.29	0.39	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	62.37	108.58 mg/L as CaCO3		

K.41 Munich 3 Using MgCO₃

Target City: Munich3 Base Water: Deionized
 Balancing pH 10.7625 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 2.5841 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	0.12 mg/L
Calcium Sulfate Dihydrate	:	15.88 mg/L
Calcium Chloride Dihydrate	:	3.99 mg/L
Magnesium Sulfate Heptahydrate	:	3.51 mg/L
Calcium Carbonate	:	126.98 mg/L
Magnesium Carbonate	:	52.92 mg/L
Sodium Bicarbonate	:	7.07 mg/L
Carbonic Acid	:	3.73 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Munich3			
pH	: 8.40	8.40		
f1	: 0.0080	0.0080		
f2	: 0.9770	0.9771		
f3	: 0.0150	0.0149		
Ionic Strength	: 6.8317	6.3168		
pfm	: 0.0389	0.0375		
Carbonates*	: 2.4918	3.8467 mM/L	+0.1886	+54.38%
Calcium*	: 76.00	55.63 mg/L	-0.1355	-26.80%
Carbonic	: 1.23	1.91 mg/L	+0.1900	+54.88%
Bicarbonate	: 148.58	229.39 mg/L	+0.1886	+54.39%
Carbonate	: 2.25	3.43 mg/K	+0.1845	+52.93%
Alkalinity (as CaCO ₃)	: 127.13	194.67 mg/L		
Chloride*	: 2.00	2.00 mg/L	+0.0000	-0.01%
Magnesium*	: 18.00	15.60 mg/L	-0.0622	-13.35%
Sodium*	: 2.00	1.98 mg/L	-0.0035	-0.80%
Sulfate*	: 10.00	10.23 mg/L	+0.0097	+2.25%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *)	: 0.09823	Corresponding %	25.3813	
pHs	: 7.38	7.32		
Saturated WRT CaCO ₃ ?	: Yes	Yes		
Langelier Index	: 1.02	1.08	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 6.36	6.24	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHc	: 8.69	8.88		
Saturated WRT CO ₂ ?	: Yes	Yes		
CO ₂ Equilibrium Index:	: 0.29	0.48	EI < 0 ~ Gains CO ₂ ; EI > 0 ~ Loses CO ₂	
Residual Alkalinity	: 62.37	145.84 mg/L as CaCO ₃		

K.42 Munich 4

Target City: Munich4 Base Water: Deionized
 Balancing pH 10.7664 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 2.5673 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	0.20 mg/L
Calcium Sulfate Dihydrate	:	0.00 mg/L
Calcium Chloride Dihydrate	:	3.91 mg/L
Magnesium Sulfate Heptahydrate	:	68.49 mg/L
Calcium Carbonate	:	149.24 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	6.98 mg/L
Carbonic Acid	:	2.93 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Munich4			
pH	8.40	8.40		
f1	0.0080	0.0080		
f2	0.9770	0.9772		
f3	0.0150	0.0147		
Ionic Strength	6.7650	5.7782		
pfm	0.0387	0.0360		
Carbonates*	2.4590	3.0412 mM/L	+0.0923	+23.67%
Calcium*	75.00	60.83 mg/L	-0.0910	-18.90%
Carbonic	1.22	1.52 mg/L	+0.0951	+24.48%
Bicarbonate	146.63	181.38 mg/L	+0.0924	+23.70%
Carbonate	2.21	2.69 mg/K	+0.0842	+21.40%
Alkalinity (as CaCO3)	125.49	154.46 mg/L		
Chloride*	2.00	2.00 mg/L	+0.0009	+0.20%
Magnesium*	18.00	6.75 mg/L	-0.4257	-62.48%
Sodium*	2.00	1.99 mg/L	-0.0025	-0.58%
Sulfate*	10.00	26.69 mg/L	+0.4264	+166.94%
Nitrate	0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.25161	Corresponding %	78.4893	
pHs	7.39	7.38		
Saturated WRT CaCO3?	Yes	Yes		
Langelier Index	1.01	1.02	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	6.38	6.35	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	8.68	8.78		
Saturated WRT CO2?	Yes	Yes		
CO2 Equilibrium Index:	0.28	0.38	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	61.45	107.13 mg/L as CaCO3		

K.43 Munich 4 Using MgCO₃

Target City: Munich4 Base Water: Deionized
 Balancing pH 10.7664 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 2.5673 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	0.97 mg/L
Calcium Sulfate Dihydrate	:	17.53 mg/L
Calcium Chloride Dihydrate	:	2.97 mg/L
Magnesium Sulfate Heptahydrate	:	1.09 mg/L
Calcium Carbonate	:	125.06 mg/L
Magnesium Carbonate	:	53.58 mg/L
Sodium Bicarbonate	:	5.84 mg/L
Carbonic Acid	:	3.71 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Munich4			
pH	: 8.40	8.40		
f1	: 0.0080	0.0080		
f2	: 0.9770	0.9771		
f3	: 0.0150	0.0149		
Ionic Strength	: 6.7650	6.2607		
pfm	: 0.0387	0.0373		
Carbonates*	: 2.4590	3.8097 mM/L	+0.1901	+54.93%
Calcium*	: 75.00	54.97 mg/L	-0.1349	-26.70%
Carbonic	: 1.22	1.89 mg/L	+0.1915	+55.43%
Bicarbonate	: 146.63	227.19 mg/L	+0.1902	+54.95%
Carbonate	: 2.21	3.40 mg/K	+0.1861	+53.50%
Alkalinity (as CaCO ₃)	: 125.49	192.82 mg/L		
Chloride*	: 2.00	2.02 mg/L	+0.0047	+1.09%
Magnesium*	: 18.00	15.55 mg/L	-0.0636	-13.61%
Sodium*	: 2.00	1.98 mg/L	-0.0048	-1.09%
Sulfate*	: 10.00	10.21 mg/L	+0.0089	+2.06%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.09876	Corresponding %	25.5326	
pHs	: 7.39	7.33		
Saturated WRT CaCO ₃ ?	: Yes	Yes		
Langelier Index	: 1.01	1.07 SI < 0 ~ Corrosion; SI > 0 ~ Occlusion		
Ryznar Index	: 6.38	6.26 RI < 6 ~ Occlusion; RI > 7 ~ Corrosion		
pHc	: 8.68	8.88		
Saturated WRT CO ₂ ?	: Yes	Yes		
CO ₂ Equilibrium Index:	0.28	0.48 EI < 0 ~ Gains CO ₂ ; EI > 0 ~ Loses CO ₂		
Residual Alkalinity	: 61.45	144.49 mg/L as CaCO ₃		

K.44 Pilsen 1

Target City: Pilsen1 Base Water: Deionized
 Balancing pH 9.8172 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 0.1227 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	3.45 mg/L
Calcium Sulfate Dihydrate	:	0.00 mg/L
Calcium Chloride Dihydrate	:	6.49 mg/L
Magnesium Sulfate Heptahydrate	:	16.13 mg/L
Calcium Carbonate	:	11.37 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	2.14 mg/L
Carbonic Acid	:	0.22 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Pilsen1			
pH	: 8.40	8.40		
f1	: 0.0085	0.0085		
f2	: 0.9788	0.9789		
f3	: 0.0127	0.0127		
Ionic Strength	: 0.8497	0.8207		
pfm	: 0.0145	0.0142		
Carbonates*	: 0.2295	0.2489 mM/L	+0.0352	+8.45%
Calcium*	: 7.00	6.32 mg/L	-0.0443	-9.70%
Carbonic	: 0.12	0.13 mg/L	+0.0355	+8.52%
Bicarbonate	: 13.71	14.87 mg/L	+0.0353	+8.46%
Carbonate	: 0.18	0.19 mg/K	+0.0345	+8.27%
Alkalinity (as CaCO3)	: 14.13	15.10 mg/L		
Chloride*	: 5.00	5.22 mg/L	+0.0187	+4.41%
Magnesium*	: 2.00	1.59 mg/L	-0.0995	-20.48%
Sodium*	: 2.00	1.94 mg/L	-0.0128	-2.91%
Sulfate*	: 5.00	6.29 mg/L	+0.0994	+25.71%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.06259	Corresponding %	15.5011	
pHs	: 9.33	9.34		
Saturated WRT CaCO3?	: No	No		
Langelier Index	: -0.93	-0.94	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 10.26	10.28	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHc	: 7.68	7.72		
Saturated WRT CO2?	: No	No		
CO2 Equilibrium Index:	-0.72	-0.68	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: 7.97	9.66 mg/L as CaCO3		

K.45 Pilsen 2

Target City: Pilsen2 Base Water: Deionized
 Balancing pH 10.6135 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 0.5823 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	1.22 mg/L
Calcium Sulfate Dihydrate	:	0.00 mg/L
Calcium Chloride Dihydrate	:	5.48 mg/L
Magnesium Sulfate Heptahydrate	:	21.18 mg/L
Calcium Carbonate	:	13.00 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	7.83 mg/L
Carbonic Acid	:	0.25 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Pilsen2			
pH	: 8.40	8.40		
f1	: 0.0084	0.0084		
f2	: 0.9787	0.9788		
f3	: 0.0129	0.0128		
Ionic Strength	: 1.1614	0.9619		
pfm	: 0.0168	0.0153		
Carbonates*	: 0.2295	0.3489 mM/L	+0.1819	+52.02%
Calcium*	: 10.00	6.70 mg/L	-0.1739	-33.00%
Carbonic	: 0.12	0.18 mg/L	+0.1834	+52.54%
Bicarbonate	: 13.71	20.84 mg/L	+0.1819	+52.03%
Carbonate	: 0.18	0.27 mg/K	+0.1775	+50.50%
Alkalinity (as CaCO3)	: 14.15	20.08 mg/L		
Chloride*	: 3.00	3.38 mg/L	+0.0521	+12.74%
Magnesium*	: 4.30	2.09 mg/L	-0.3136	-51.42%
Sodium*	: 3.00	2.62 mg/L	-0.0582	-12.54%
Sulfate*	: 4.00	8.26 mg/L	+0.3148	+106.43%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.21088	Corresponding %	62.5118	
pHs	: 9.19	9.17		
Saturated WRT CaCO3?	: No	No		
Langelier Index	: -0.79	-0.77	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 9.97	9.94	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 7.68	7.86		
Saturated WRT CO2?	: No	No		
CO2 Equilibrium Index:	-0.72	-0.54	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: 4.50	14.07 mg/L as CaCO3		

K.46 Pilsen 2 Usign MgCO₃.

Target City: Pilsen2 Base Water: Deionized
 Balancing pH 10.6135 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 0.5823 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	2.96 mg/L
Calcium Sulfate Dihydrate	:	2.87 mg/L
Calcium Chloride Dihydrate	:	3.52 mg/L
Magnesium Sulfate Heptahydrate	:	7.90 mg/L
Calcium Carbonate	:	11.59 mg/L
Magnesium Carbonate	:	7.59 mg/L
Sodium Bicarbonate	:	5.07 mg/L
Carbonic Acid	:	0.40 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Pilsen2			
pH	: 8.40	8.40		
f1	: 0.0084	0.0084		
f2	: 0.9787	0.9788		
f3	: 0.0129	0.0128		
Ionic Strength	: 1.1614	0.9989		
pfm	: 0.0168	0.0156		
Carbonates*	: 0.2295	0.4673 mM/L	+0.3088	+103.61%
Calcium*	: 10.00	6.27 mg/L	-0.2029	-37.32%
Carbonic	: 0.12	0.24 mg/L	+0.3100	+104.18%
Bicarbonate	: 13.71	27.91 mg/L	+0.3088	+103.63%
Carbonate	: 0.18	0.36 mg/K	+0.3053	+101.97%
Alkalinity (as CaCO ₃)	: 14.15	25.97 mg/L		
Chloride*	: 3.00	3.49 mg/L	+0.0660	+16.42%
Magnesium*	: 4.30	2.97 mg/L	-0.1611	-30.99%
Sodium*	: 3.00	2.55 mg/L	-0.0699	-14.87%
Sulfate*	: 4.00	4.68 mg/L	+0.0681	+16.99%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.17145	Corresponding %	48.4040	
pHs	: 9.19	9.07		
Saturated WRT CaCO ₃ ?	: No	No		
Langelier Index	: -0.79	-0.67	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 9.97	9.75	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 7.68	7.99		
Saturated WRT CO ₂ ?	: No	No		
CO ₂ Equilibrium Index:	-0.72	-0.41	EI < 0 ~ Gains CO ₂ ; EI > 0 ~ Loses CO ₂	
Residual Alkalinity	: 4.50	19.76 mg/L as CaCO ₃		

K.47 Pilsen3

Target City: Pilsen3 Base Water: Deionized
 Balancing pH 10.1633 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 0.2470 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	3.70 mg/L
Calcium Sulfate Dihydrate	:	0.00 mg/L
Calcium Chloride Dihydrate	:	6.28 mg/L
Magnesium Sulfate Heptahydrate	:	20.60 mg/L
Calcium Carbonate	:	11.63 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	1.77 mg/L
Carbonic Acid	:	0.23 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Pilsen3			
pH	: 8.40	8.40		
f1	: 0.0084	0.0085		
f2	: 0.9788	0.9788		
f3	: 0.0128	0.0127		
Ionic Strength	: 0.9658	0.8968		
pfm	: 0.0154	0.0148		
Carbonates*	: 0.2295	0.2498 mM/L	+0.0368	+8.84%
Calcium*	: 7.10	6.37 mg/L	-0.0472	-10.30%
Carbonic	: 0.12	0.13 mg/L	+0.0374	+8.98%
Bicarbonate	: 13.71	14.92 mg/L	+0.0368	+8.85%
Carbonate	: 0.18	0.19 mg/K	+0.0352	+8.44%
Alkalinity (as CaCO3)	: 14.14	15.15 mg/L		
Chloride*	: 5.00	5.27 mg/L	+0.0229	+5.41%
Magnesium*	: 3.40	2.03 mg/L	-0.2236	-40.25%
Sodium*	: 2.00	1.94 mg/L	-0.0131	-2.98%
Sulfate*	: 4.80	8.03 mg/L	+0.2235	+67.29%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.13180	Corresponding %	35.4570	
pHs	: 9.33	9.34		
Saturated WRT CaCO3?	: No	No		
Langelier Index	: -0.93	-0.94	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 10.26	10.27	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 7.68	7.72		
Saturated WRT CO2?	: No	No		
CO2 Equilibrium Index:	-0.72	-0.68	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: 7.08	9.41 mg/L as CaCO3		

K.48 Pilsen 3 Using MgCO₃.

Target City: Pilsen3 Base Water: Deionized
 Balancing pH 10.1633 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 0.2470 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	4.67 mg/L
Calcium Sulfate Dihydrate	:	6.98 mg/L
Calcium Chloride Dihydrate	:	6.19 mg/L
Magnesium Sulfate Heptahydrate	:	3.72 mg/L
Calcium Carbonate	:	5.47 mg/L
Magnesium Carbonate	:	8.31 mg/L
Sodium Bicarbonate	:	0.09 mg/L
Carbonic Acid	:	0.30 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Pilsen3			
pH	: 8.40	8.40		
f1	: 0.0084	0.0085		
f2	: 0.9788	0.9788		
f3	: 0.0128	0.0127		
Ionic Strength	: 0.9658	0.8914		
pfm	: 0.0154	0.0148		
Carbonates*	: 0.2295	0.3037 mM/L	+0.1216	+32.32%
Calcium*	: 7.10	5.50 mg/L	-0.1107	-22.50%
Carbonic	: 0.12	0.16 mg/L	+0.1222	+32.50%
Bicarbonate	: 13.71	18.14 mg/L	+0.1216	+32.32%
Carbonate	: 0.18	0.23 mg/K	+0.1199	+31.79%
Alkalinity (as CaCO ₃)	: 14.14	17.83 mg/L		
Chloride*	: 5.00	5.81 mg/L	+0.0655	+16.29%
Magnesium*	: 3.40	2.76 mg/L	-0.0902	-18.75%
Sodium*	: 2.00	1.86 mg/L	-0.0312	-6.94%
Sulfate*	: 4.80	5.34 mg/L	+0.0467	+11.34%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.08428	Corresponding %	21.4182	
pHs	: 9.33	9.31		
Saturated WRT CaCO ₃ ?	: No	No		
Langelier Index	: -0.93	-0.91	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 10.26	10.23	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pH _e	: 7.68	7.80		
Saturated WRT CO ₂ ?	: No	No		
CO ₂ Equilibrium Index:	-0.72	-0.60	EI < 0 ~ Gains CO ₂ ; EI > 0 ~ Loses CO ₂	
Residual Alkalinity	: 7.08	12.28 mg/L as CaCO ₃		

K.49 Potomac River

Target City: Potomac Ri Base Water: Dei onized
 Balancing pH 7.6461 is within acceptable bounds
 Net charge (imbalance) at this pH: 0.0000 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodi um Chloride	:	2.46	mg/L
Cal ci um Sul fate Di hydrate	:	0.00	mg/L
Cal ci um Chloride Di hydrate	:	29.82	mg/L
Magnesi um Sul fate Heptahydrate	:	81.00	mg/L
Cal ci um Carbonate	:	69.93	mg/L
Magnesi um Carbonate	:	0.00	mg/L
Sodi um Bi carbonate	:	29.58	mg/L
Carboni c Acid	:	1.55	mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Potomac River			
pH	7.65	7.65		
f1	0.0449	0.0449		
f2	0.9526	0.9526		
f3	0.0025	0.0025		
Ionic Strength	4.4137	4.4131		
pfm	0.0317	0.0317		
Carbonates*	1.8852	1.8264 mM/L	-0.0138	-3.12%
Cal ci um*	35.00	36.13 mg/L	+0.0138	+3.23%
Carboni c	5.25	5.09 mg/L	-0.0138	-3.12%
Bi carbonate	109.61	106.18 mg/L	-0.0138	-3.12%
Carbonate	0.28	0.27 mg/K	-0.0138	-3.12%
Alkali nity (as CaCO3)	92.07	89.28 mg/L		
Chloride*	16.00	15.87 mg/L	-0.0035	-0.80%
Magnesi um*	9.00	7.99 mg/L	-0.0518	-11.25%
Sodi um*	9.00	9.06 mg/L	+0.0029	+0.68%
Sulfate*	28.00	31.57 mg/L	+0.0521	+12.75%
Nitrate	2.40	0.00 mg/L		
RMS Log Error (Items with *):	0.03110	Corresponding %	7.4230	
pHs	7.81	7.81		
Saturated WRT CaCO3?	No	No		
Langelier Index	-0.17	-0.17	SI < 0 ~ Corrosion; SI > 0 ~ Occl usi on	
Ryznar Index	7.98	7.98	RI < 6 ~ Occl usi on; RI > 7 ~ Corrosi on	
pHe	8.57	8.55		
Saturated WRT CO2?	Yes	Yes		
CO2 Equilibrium Index:	0.92	0.91	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	61.83	58.83 mg/L as CaCO3		

K.50 Potomac River Using MgCO₃

Target City: Potomac Ri Base Water: Deionized
 Balancing pH 7.6461 is within acceptable bounds
 Net charge (imbalance) at this pH: 0.0000 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	10.29 mg/L
Calcium Sulfate Dihydrate	:	38.95 mg/L
Calcium Chloride Dihydrate	:	20.35 mg/L
Magnesium Sulfate Heptahydrate	:	16.30 mg/L
Calcium Carbonate	:	50.08 mg/L
Magnesium Carbonate	:	25.56 mg/L
Sodium Bicarbonate	:	18.05 mg/L
Carbonic Acid	:	1.77 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Potomac River			
pH	7.65	7.65		
f1	0.0449	0.0449		
f2	0.9526	0.9526		
f3	0.0025	0.0025		
Ionic Strength	4.4137	4.3860		
pfm	0.0317	0.0317		
Carbonates*	1.8852	1.9022 mM/L	+0.0039	+0.90%
Calcium*	35.00	34.67 mg/L	-0.0041	-0.95%
Carbonic	5.25	5.30 mg/L	+0.0040	+0.92%
Bicarbonate	109.61	110.59 mg/L	+0.0039	+0.90%
Carbonate	0.28	0.28 mg/K	+0.0036	+0.83%
Alkalinity (as CaCO ₃)	92.07	92.87 mg/L		
Chloride*	16.00	16.05 mg/L	+0.0014	+0.33%
Magnesium*	9.00	8.98 mg/L	-0.0012	-0.27%
Sodium*	9.00	8.99 mg/L	-0.0007	-0.16%
Sulfate*	28.00	28.08 mg/L	+0.0013	+0.30%
Nitrate	2.40	0.00 mg/L		
RMS Log Error (Items with *):	0.00251	Corresponding %	0.5792	
pHs	7.81	7.81		
Saturated WRT CaCO ₃ ?	No	No		
Langelier Index	-0.17	-0.17	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	7.98	7.98	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	8.57	8.57		
Saturated WRT CO ₂ ?	Yes	Yes		
CO ₂ Equilibrium Index:	0.92	0.92	EI < 0 ~ Gains CO ₂ ; EI > 0 ~ Loses CO ₂	
Residual Alkalinity	61.83	62.88 mg/L as CaCO ₃		

K.51 Vienna 1

Target City: Vienna1 Base Water: Deionized
 Balancing pH 11.8636 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 10.3682 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	0.02 mg/L
Calcium Sulfate Dihydrate	:	185.27 mg/L
Calcium Chloride Dihydrate	:	26.14 mg/L
Magnesium Sulfate Heptahydrate	:	394.80 mg/L
Calcium Carbonate	:	127.47 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	27.91 mg/L
Carbonic Acid	:	2.48 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Vienna1			
pH	: 8.40	8.40		
f1	: 0.0076	0.0077		
f2	: 0.9749	0.9755		
f3	: 0.0175	0.0169		
Ionic Strength	: 18.8557	15.4195		
pfm	: 0.0614	0.0562		
Carbonates*	: 1.9344	2.8482 mM/L	+0.1680	+47.24%
Calcium*	: 200.00	101.30 mg/L	-0.2954	-49.35%
Carbonic	: 0.91	1.35 mg/L	+0.1734	+49.09%
Bicarbonate	: 115.10	169.56 mg/L	+0.1682	+47.31%
Carbonate	: 2.03	2.89 mg/K	+0.1527	+42.12%
Alkalinity (as CaCO3)	: 99.73	145.28 mg/L		
Chloride*	: 12.00	12.62 mg/L	+0.0218	+5.14%
Magnesium*	: 60.00	38.93 mg/L	-0.1878	-35.11%
Sodium*	: 8.00	7.65 mg/L	-0.0197	-4.43%
Sulfate*	: 125.00	257.24 mg/L	+0.3134	+105.79%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.20408	Corresponding %	59.9841	
pHs	: 7.18	7.29		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 1.22	1.11	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 5.97	6.17	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHc	: 8.56	8.73		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.16	0.33	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: -78.12	50.18 mg/L as CaCO3		

K.52 Vienna 2

Target City: Vienna2 Base Water: Deionized
 Balancing pH 10.9435 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 4.4527 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	0.35 mg/L
Calcium Sulfate Dihydrate	:	69.15 mg/L
Calcium Chloride Dihydrate	:	83.89 mg/L
Magnesium Sulfate Heptahydrate	:	580.01 mg/L
Calcium Carbonate	:	223.93 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	28.33 mg/L
Carbonic Acid	:	4.37 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Vienna2			
pH	: 8.40	8.40		
f1	: 0.0075	0.0075		
f2	: 0.9746	0.9748		
f3	: 0.0178	0.0177		
Ionic Strength	: 20.9941	19.8221		
pfm	: 0.0643	0.0627		
Carbonates*	: 3.9836	4.7597 mM/L	+0.0773	+19.48%
Calcium*	: 163.00	128.64 mg/L	-0.1028	-21.08%
Carbonic	: 1.86	2.23 mg/L	+0.0790	+19.94%
Bicarbonate	: 236.95	283.17 mg/L	+0.0774	+19.50%
Carbonate	: 4.27	5.05 mg/K	+0.0726	+18.20%
Alkalinity (as CaCO3)	: 202.25	241.01 mg/L		
Chloride*	: 39.00	40.67 mg/L	+0.0182	+4.29%
Magnesium*	: 68.00	57.20 mg/L	-0.0751	-15.89%
Sodium*	: 8.00	7.89 mg/L	-0.0060	-1.36%
Sulfate*	: 216.00	264.63 mg/L	+0.0882	+22.52%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.07111	Corresponding %	17.7902	
pHs	: 6.97	6.99		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 1.43	1.41	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 5.55	5.58	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 8.87	8.95		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.47	0.55	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: 46.08	115.69 mg/L as CaCO3		

K.53 Vienna 3

Target City: Vienna3 Base Water: Deionized
 Balancing pH 11.8602 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 10.3351 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	1.41	mg/L
Calcium Sulfate Dihydrate	:	179.12	mg/L
Calcium Chloride Dihydrate	:	24.35	mg/L
Magnesium Sulfate Heptahydrate	:	395.20	mg/L
Calcium Carbonate	:	132.40	mg/L
Magnesium Carbonate	:	0.00	mg/L
Sodium Bicarbonate	:	25.94	mg/L
Carbonic Acid	:	2.58	mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET	SYNTHESIS	pRatio	Pct Err
	Vienna3			
pH	: 8.40	8.40		
f1	: 0.0076	0.0077		
f2	: 0.9749	0.9755		
f3	: 0.0175	0.0169		
Ionic Strength	: 18.8725	15.3956		
pfm	: 0.0614	0.0561		
Carbonates*	: 1.9672	2.9225 mM/L	+0.1719	+48.56%
Calcium*	: 200.00	101.36 mg/L	-0.2952	-49.32%
Carbonic	: 0.92	1.39 mg/L	+0.1774	+50.45%
Bicarbonate	: 117.05	173.98 mg/L	+0.1721	+48.64%
Carbonate	: 2.07	2.96 mg/K	+0.1564	+43.34%
Alkalinity (as CaCO3)	: 101.37	149.00 mg/L		
Chloride*	: 12.00	12.60 mg/L	+0.0212	+5.00%
Magnesium*	: 60.00	38.97 mg/L	-0.1874	-35.05%
Sodium*	: 8.00	7.65 mg/L	-0.0193	-4.34%
Sulfate*	: 125.00	253.97 mg/L	+0.3079	+103.17%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.20306	Corresponding %	59.6097	
pHs	: 7.18	7.27		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 1.22	1.13	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 5.95	6.15	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHe	: 8.56	8.74		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.16	0.34	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: -76.48	53.83 mg/L as CaCO3		

K.54 Yorkshire

Target City: Yorkshire Base Water: Deionized
 Balancing pH 10.7828 is greater than 8.40 and is thus set to 8.40
 Net charge (imbalance) at this pH: 2.6312 mEq/L

SALTS ADDED FOR THIS SYNTHESIS:

Sodium Chloride	:	17.31 mg/L
Calcium Sulfate Dihydrate	:	36.78 mg/L
Calcium Chloride Dihydrate	:	45.62 mg/L
Magnesium Sulfate Heptahydrate	:	137.99 mg/L
Calcium Carbonate	:	129.92 mg/L
Magnesium Carbonate	:	0.00 mg/L
Sodium Bicarbonate	:	58.88 mg/L
Carbonic Acid	:	2.54 mEq/L

COMPARISON OF TARGET AND SYNTHESIS:

	TARGET Yorkshire	SYNTHESIS	pRatio	Pct Err
pH	: 8.40	8.40		
f1	: 0.0079	0.0079		
f2	: 0.9764	0.9766		
f3	: 0.0157	0.0155		
Ionic Strength	: 9.8059	8.9442		
pfm	: 0.0459	0.0440		
Carbonates*	: 2.4590	3.2685 mM/L	+0.1236	+32.92%
Calcium*	: 100.00	73.03 mg/L	-0.1365	-26.97%
Carbonic	: 1.20	1.60 mg/L	+0.1255	+33.52%
Bicarbonate	: 146.53	194.80 mg/L	+0.1237	+32.94%
Carbonate	: 2.32	3.05 mg/K	+0.1180	+31.23%
Alkalinity (as CaCO3)	: 125.63	165.98 mg/L		
Chloride*	: 30.00	32.50 mg/L	+0.0348	+8.34%
Magnesium*	: 15.00	13.61 mg/L	-0.0423	-9.28%
Sodium*	: 25.00	22.92 mg/L	-0.0377	-8.31%
Sulfate*	: 65.00	74.30 mg/L	+0.0581	+14.31%
Nitrate	: 0.00	0.00 mg/L		
RMS Log Error (Items with *):	0.08337	Corresponding %	21.1630	
pHs	: 7.30	7.31		
Saturated WRT CaCO3?	: Yes	Yes		
Langelier Index	: 1.10	1.09	SI < 0 ~ Corrosion; SI > 0 ~ Occlusion	
Ryznar Index	: 6.21	6.21	RI < 6 ~ Occlusion; RI > 7 ~ Corrosion	
pHc	: 8.68	8.80		
Saturated WRT CO2?	: Yes	Yes		
CO2 Equilibrium Index:	0.28	0.40	EI < 0 ~ Gains CO2; EI > 0 ~ Loses CO2	
Residual Alkalinity	: 45.53	105.93 mg/L as CaCO3		