

Mixing Water for Concrete





Objectives

- Introduce mixing water standards
- Common mixing water sources
- Overview of impurities and their impact



ASTM C1602

Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

- Potable water – no testing needed
- Non-potable or combined mixing water – testing required
- Recycled water – solids content tested daily

Sources of Mixing Water



At the Batch Plant

- ◆ Municipal water supply
- ◆ Municipal reclaimed water
- ◆ Recycled water from concrete production operations

Municipal Water

Typical Analyses of City Water Supplies and Seawater (parts per million)

Chemicals	Analysis No.						Seawater*
	1	2	3	4	5	6	
Silica (SiO ₂)	2.4	0.0	6.5	9.4	22.0	3.0	—
Iron (Fe)	0.1	0.0	0.0	0.2	0.1	0.0	—
Calcium (Ca)	5.8	15.3	29.5	96.0	3.0	1.3	50 to 480
Magnesium (Mg)	1.4	5.5	7.6	27.0	2.4	0.3	260 to 1410
Sodium (Na)	1.7	16.1	2.3	183.0	215.0	1.4	2190 to 12,200
Potassium (K)	0.7	0.0	1.6	18.0	9.8	0.2	70 to 550
Bicarbonate (HCO ₃)	14.0	35.8	122.0	334.0	549.0	4.1	—
Sulfate (SO ₄)	9.7	59.9	5.3	121.0	11.0	2.6	580 to 2810
Chloride (Cl)	2.0	3.0	1.4	280.0	22.0	1.0	3960 to 20,000
Nitrate (NO ₃)	0.5	0.0	1.6	0.2	0.5	0.0	—
Total dissolved solids	31.0	250.0	125.0	983.0	564.0	19.0	35,000

* Different seas contain different amounts of dissolved salts.

Municipal Reclaimed Water

WE CONSERVE

**IRRIGATED WITH
RECLAIMED WATER. DO
NOT DRINK FROM
THE IRRIGATION SYSTEM.**

CONSERVEMOS AGUA

**SE UTILIZA AGUA
RECLAMADA.
NO BEBA
AGUA DEL
SISTEMA
DE RIEGO.**

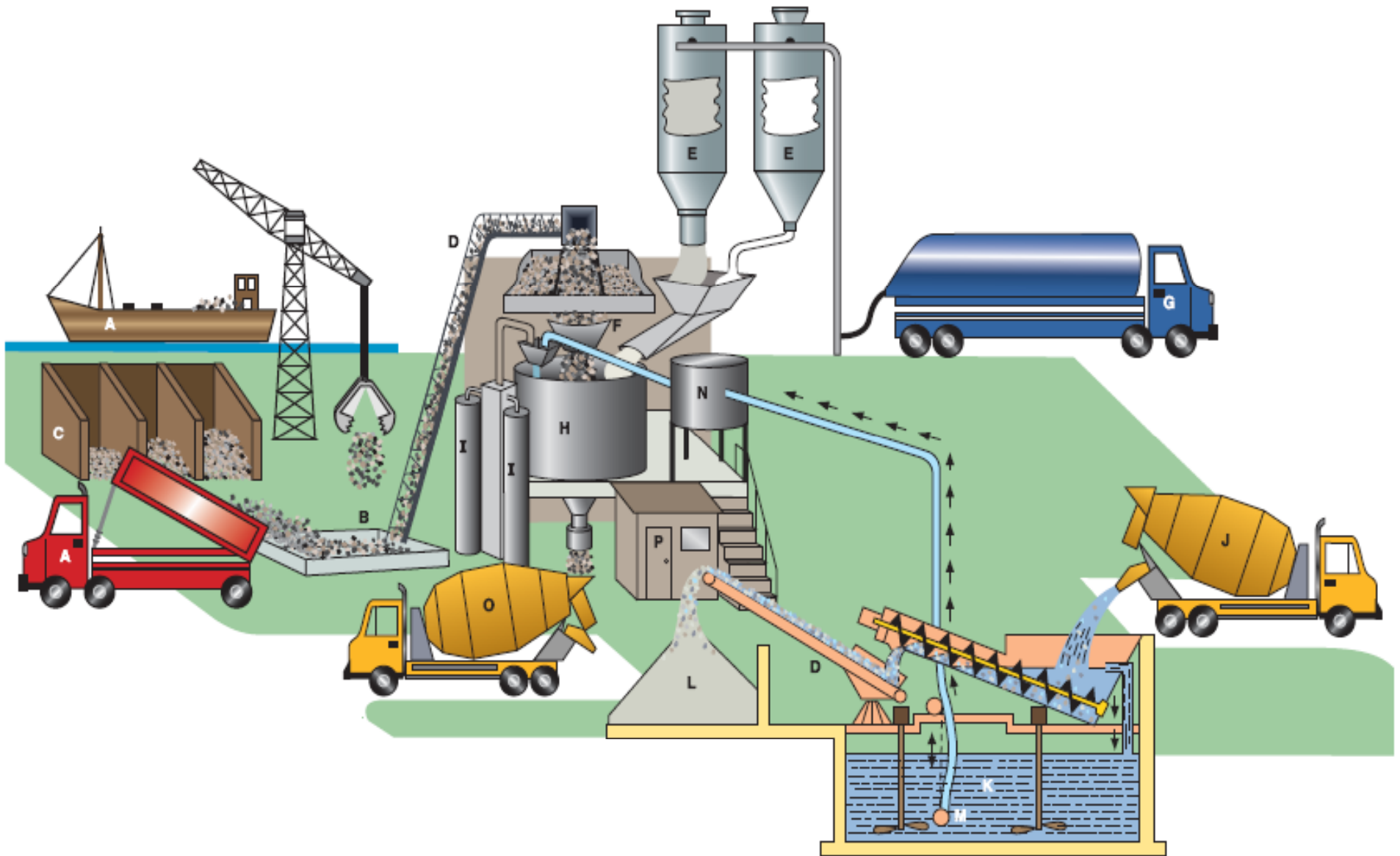


For more information on reclaimed water call the Austin Water Utility at 972-0108.

Recycled Water



- Mixer wash water
- Stormwater runoff
- Water containing concrete ingredients

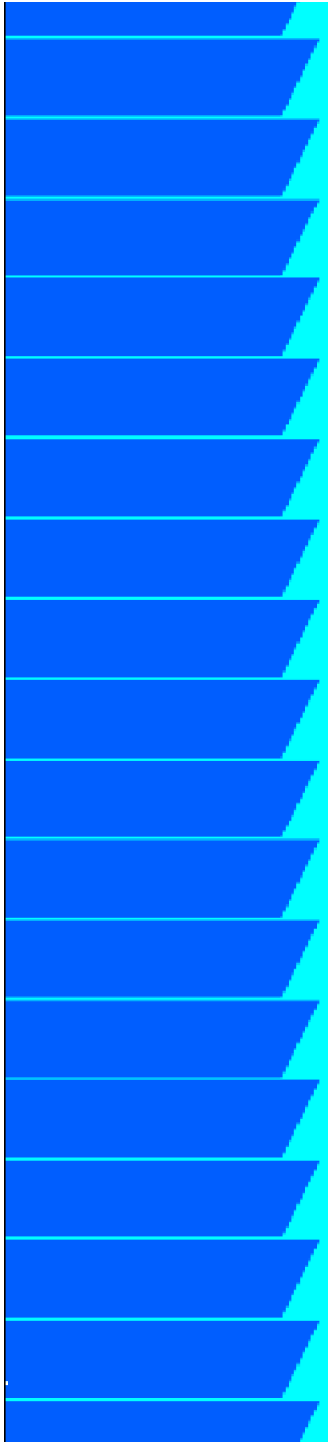


- | | |
|---------------------------------|--|
| A Aggregate delivery | I Admixtures |
| B Aggregate receiving hopper | J Ready mix truck with returned concrete |
| C Aggregate storage | K Recycled water |
| D Conveyor belt | L Reclaimed aggregates |
| E Cementitious material storage | M Pump |
| F Weigh hopper | N Water storage |
| G Cement delivery | O Concrete loaded in ready-mix truck |
| H Mixer | P Control Room |













Acceptance Criteria for Questionable Water Supplies

	Limits	Test method
Compressive strength, minimum percentage of control at 7 days	90	C31, C39
Time of set, deviation from control, hr:min	From 1:00 earlier to 1:30 later	C403

*Comparisons should be based on fixed proportions of a concrete mix design representative of questionable water supply and a control mixture using 100% potable water.

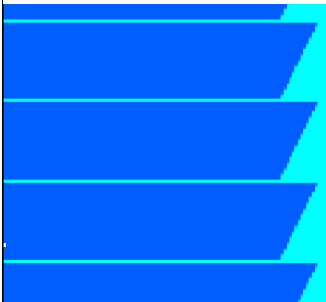


Optional Acceptance Criteria for Combined Water Supplies

Chemical or type of construction	Maximum concentration, ppm*	Test method
Chloride, as Cl		ASTM C114
Prestressed concrete or concrete in bridge decks	500**	
Other reinforced concrete in moist environments or containing aluminum embedments or dissimilar metals or with stay-in-place galvanized metal forms	1,000**	
Sulfate, as SO ₄	3,000	ASTM C114
Alkalies, as (Na ₂ O + 0.658 K ₂ O)	600	ASTM C114
Total solids by mass	50,000	ASTM C1603

* ppm is the abbreviation for parts per million.

** The requirements for concrete in ACI 318 shall govern when the manufacturer can demonstrate that these limits for mixing water can be exceeded. For conditions allowing the use of calcium chloride (CaCl₂) accelerator as an admixture, the chloride limitation is permitted to be waived by the purchaser.





ACI 318 Limits for Chloride Ion Content in Concrete

- Prestressed concrete 0.06%
- Reinforced concrete exposed to chloride in service 0.15%
- Reinforced concrete that will be dry or protected from moisture in service 1.00%
- Other reinforced concrete construction 0.30%

Note: No limits for concrete not containing steel

Impurities and Strength

High Impact

Sodium Sulfide

Salts of Zinc, Copper, and Lead

Sugar

Algae



Impurities and Strength

Moderate Impact

Alkali Carbonate/Bicarbonate

Salts of Manganese and Tin

Sodium Iodate/Phosphate/Borate/Arsenate

Organic Acids

Industrial Wastewater

Seawater



Impurities and Strength

Low Impact

Calcium/Magnesium Bicarbonate

Magnesium Sulfate/Chloride

Iron Salts

Inorganic Acids

Alkali Hydroxides

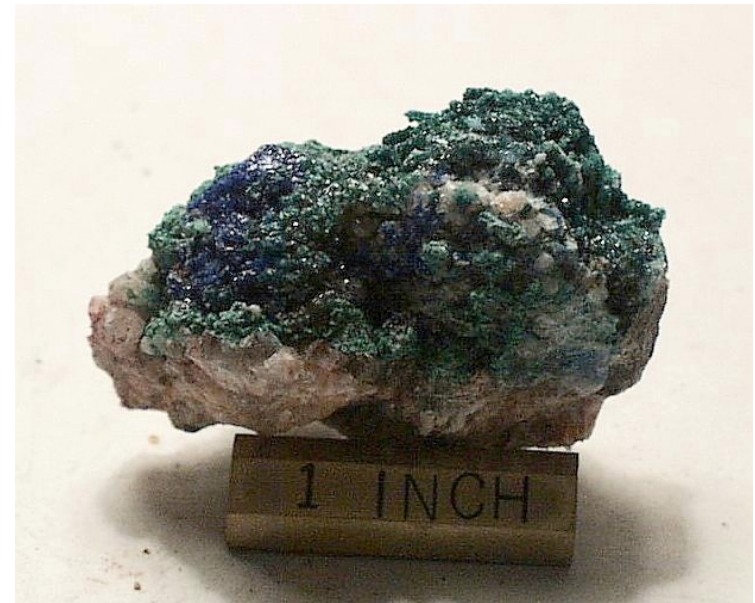
Oils



Impurities and Setting Time

High Impact

Sodium Carbonate
Salts of Zinc, Copper, and Lead
Sugar



Impurities and Setting Time

Moderate
Impact

Alkali Bicarbonate
Salts of Manganese and Tin
Sodium Iodate/Phosphate/Borate/Arsenate
Sodium Sulfide
Alkali Hydroxides
Industrial Wastewater





Impurities and Durability

Alkali-Aggregate Reactivity	Alkalis, Seawater
Corrosion Resistance	Chlorides, Seawater
Freeze-Thaw Resistance	Algae
Sulfate Attack	Sulfates, Seawater



Impurities and Other Properties

Workability	Silt or Suspended Particles
Efflorescence	High salt contents (Seawater)
Admixture Compatibility	Competing ionic species (Sulfates with water-reducers)



Typical Impurities

Cations

- Calcium (Ca^{+2})
- Magnesium (Mg^{+2})
- Sodium (Na^{+})
- Potassium (K^{+})

Anions

- Bicarbonate (HCO_3^{-})
- Carbonate (CO_3^{-2})
- Sulfate (SO_4^{-2})
- Chloride (Cl^{-})
- Nitrate (NO_3^{-})

Most fresh water does not contain other impurities over 15 ppm.



Summary

- ASTM C1602 - Performance Specification
- Water has many sources
- Impurities can affect more than just strength and setting time

