RCT and RCTW

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Purpose

The **RCT** and **RCTW** systems are used to accurately and quickly determine the chloride ion content from powder samples of concrete obtained on-site or in the laboratory using the **Profile Grinder** or other means. The test results can be used for:

- Establishing the chloride ion profile for service life estimation (see pg. 114)
- Establishing the depth of removal of a chloride ion contaminated surface layer
- Diagnosing a structure for corrosion activity, in combination with other test systems such the **Mini Great Dane**, the **GalvaPulse**, and the **Rainbow Indicator**
- Monitoring the chloride ion content during electrochemical removal of chlorides
- Measuring the chloride ion content of fresh concrete or its constituents

Principle

A powder sample of hardened concrete is obtained by drilling or grinding the cover concrete in the structure, or a sample is obtained from the fresh concrete. The sample is mixed with a specific amount of extraction liquid and shaken for five minutes. The extraction liquid is designed to remove disturbing ions, such as sulfide ions, and extracts the chloride ions in the sample.

A calibrated electrode is submerged into the solution to determine the amount of chloride ion, which is expressed as percentage of concrete mass.

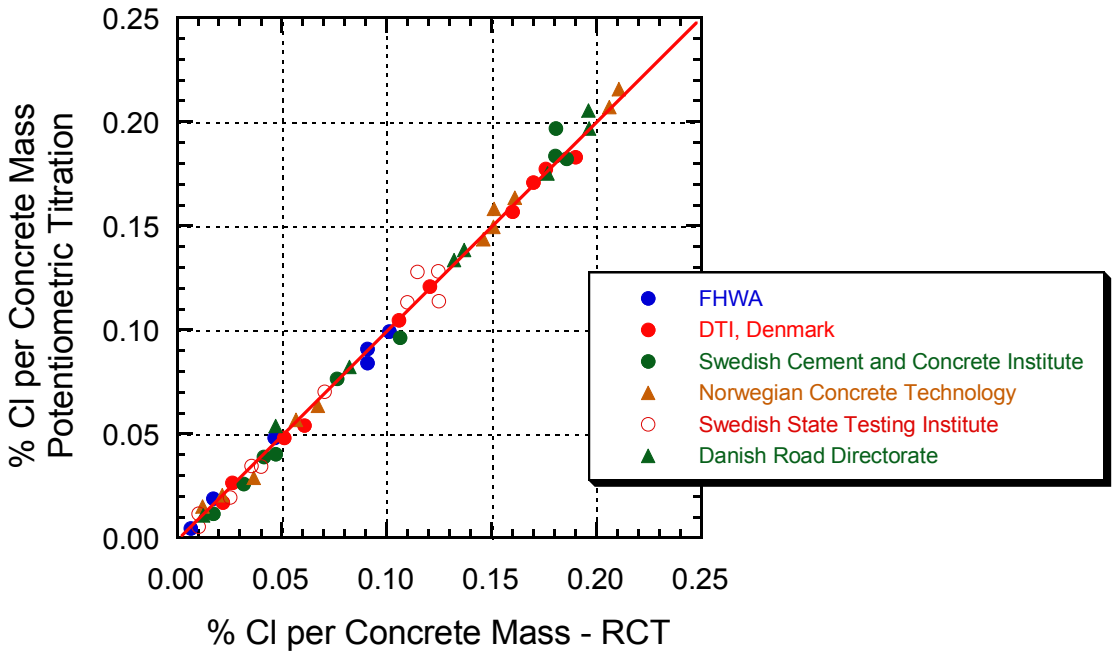
Two extraction methods are used:

- The **RCT** (**R**apid **C**hloride **T**est) is used to determine the amount of acid-soluble chlorides
- The **RCTW** (**R**apid **C**hloride **T**est **W**ater) is used to determine the amount of water-soluble chlorides

The two methods use different kinds of extraction liquids. The type of method to use will depend on the specification criteria for maximum allowable chloride ion content in either hardened or fresh concrete. Note that the acid extraction does not remove chemically bound chlorides.

Accuracy

Numerous correlations have been made between **RCT** test results and chloride ion content determined by standard laboratory potentiometric titration methods such as AASHTO T 260, ASTM C114, DS 423.28 or NS 3671. The following graph shows the results of such correlations made by various laboratories in the Scandinavian countries and in the U.S.



In one comparison, the Swedish National Testing Institute produced concrete powders containing known amounts of chloride ion introduced into the concrete by diffusion. The concretes were made with different binders as illustrated in the table below. Parallel testing was done in accordance with, AASHTO T 260 and with the **RCT** system. The **RCT** readings were taken after the powder samples were kept in the extraction liquid overnight to obtain full extraction of acid-soluble chlorides. Alternatively, if the result is obtained after 5 minutes of shaking of the vial, a correction factor can be applied to the measured chloride ion content.

The following table compares the known chloride ion content with the values determined by the **RCT** and by AASHTO T 260.

	% Cl^- per Mass of Concrete		
	Known Amount	AASHTO T 260	**RCT**
Portland Cement (CEM I)	0.023 0.071 0.328	0.024 0.070 0.314	0.022 0.072 0.321
Fly Ash Cement (CEM II/B-V)	0.020 0.057 0.244	0.019 0.052 0.229	0.019 0.061 0.238
Slag Cement (CEM III/B)	0.020 0.056 0.244	0.019 0.052 0.231	0.019 0.059 0.238

The accuracy of the **RCT** results compared with the known amount of chlorides is as good as with the AASHTO T 260 potentiometric titration method. The average deviation of the **RCT** results from the known amount of chlorides is within ± 4 %.

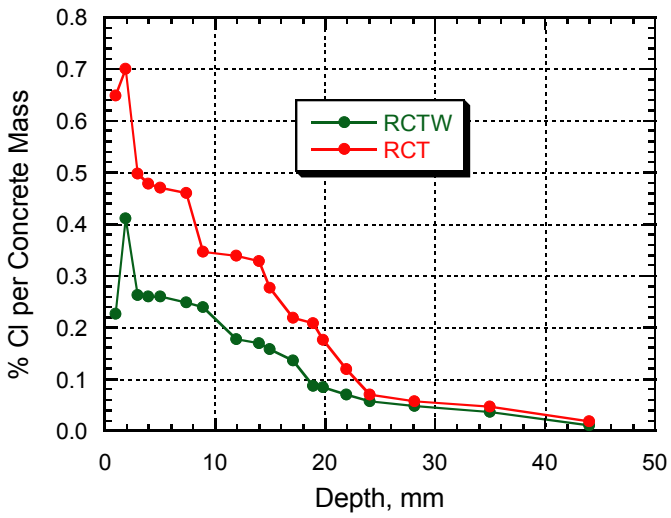
For repeated testing with the **RCT** on the same concrete powder, the coefficient of variation of test results is on average 5 %.

The precision and accuracy of the **RCTW** test for water-soluble chlorides is similar to **RCT** results.

Testing Examples

An example of a chloride ion profile measured with the **RCT** is illustrated on page 115.

The graph to the right shows two other profiles that were obtained from on-site profile grinding on a highway bridge column exposed to deicing salts for 4 years. Concrete powder samples were obtained at depth increments of 1 to 2 mm and were analyzed for acid-soluble chlorides with the **RCT** and for water-soluble chlorides with the **RCTW**. The depth of carbonation was measured to be 2 mm using the **Rainbow Indicator**, corresponding to the initial peaks of the chloride ion profiles obtained.



RCT and RCTW Ordering Numbers

Item	Order #
RCT chloride electrode	RCT-770
Electrometer for mV, pH and °C	RCT-990
Electrode wetting agent, 80 mL, w. spout	RCT-1000
Distilled water, spray bottle	RCT-1001
Polishing strips for electrode	RCT-1002
Plastic bags for powder sampling	RCT-1003
Powder collecting bowl	RCT-1004
Powder collecting pan, circular	RCT-1005
Powder collecting square w. clip	RCT-1006
Adjustable pliers	RCT-1007
Set of anchoring tools	RCT-1008
Mandrel	RCT-1009
Hammer	RCT-1010
Powder compression pin	RCT-1011
Powder weighing ampoules, 6 pcs	RCT-1012
Calibration liquid, 0.005 % Cl^-	RCT-1013
Calibration liquid, 0.020 % Cl^-	RCT-1014
Calibration liquid, 0.050 % Cl^-	RCT-1015
Calibration liquid, 0.500 % Cl^-	RCT-1016
Cleaning tissues	RCT-1017
Calibration sheets for hardened concrete	RCT-1018
Calibration sheets for fresh concrete	RCT-1019
Rubber ball dust remover	RCT-1020
Pencil and ruler	RCT-1021
Measuring tape	RCT-1022
Extraction vials, hardened concrete, 10 pcs	RCT-1023
Manual	RCT-1024
RCT calibrations and applications, binder	RCT-1025
Attaché case	RCT-1026

RCT-500

The manual included in the RCT-500 kit covers testing for acid and water-soluble chlorides in hardened as well as in fresh concrete. Separately delivered is a binder (RCT-1100) with 15 years of testing experience, including an advanced theory for chloride diffusion modeling.

Extra Parts

RCT-1030 set of calibration liquids

RCT-1000-1 electrode wetting agent

RCT-1032 mixing container and cup

It is recommended to always have an extra set of clean RCT-1030 calibration liquids to ensure that the chloride electrode is working properly should deviations occur from the usual obtained calibration curve. The RCT-1000-1 EWA (electrode wetting agent) contains 300 mL of liquid for refilling the RCT-1000 EWA bottle, which has a spout that fits into the electrode hole. The RCT-1032 mixing container and cup is for testing samples of fresh concrete.

Consumables

Extraction liquids for **RCT** testing for acid-soluble chlorides in hardened concrete or fresh concrete:

RCT-1023 *vials, set of 25, for testing hardened concrete*

RCT-1031 *vials, set of 4, for testing fresh concrete*

Extraction liquids for **RCTW** testing for water-soluble chlorides in hardened concrete or fresh concrete:

RCTW-1023-1 *vials, set of 25,*
RCTW-1023-2 *buffer vials, set of 25, for testing hardened concrete*

RCTW-1031-1 *vials, set of 4,*
RCTW-1031-2 *buffer vials, set of 4, for testing fresh concrete*

Optional items

RCT-*1030 Certified Reference Powders*
Nine jars, each containing 70 grams of concrete powder, with known amounts of chlorides and titrated according to AASHTO T 260

Cement type*	Known amounts of Cl^-		
Portland cement	0.023 %	0.071 %	0.328 %
Fly ash cement	0.020 %	0.057 %	0.244 %
Slag cement	0.020 %	0.056 %	0.244 %

*According to ENV- 197-1

RCT-995 *the 1.5 g balance for checking the powder weighing ampoules supplied in the* **RCT**-500 *kit*

RCT-1028 *pH-electrode*

RCT-1029 *temperature probe*