Determination of Calcium Carbonate in Soils  
(Calcimeter Bernard Method)

Percentage of calcium carbonate, CaCO₃ (%), is defined as the total carbonates which is contained in 100 g of dry soil. We express total carbonates, (CaCO₃, MgCO₃ etc.) as CaCO₃.

**Principle**

The determination of CaCO₃ (%) is based on the volumetric analysis of the carbon dioxide CO₂, which is liberated during the application of hydrochloric acid solution HCl 4 N in soil’s carbonates and is described with the following reaction:

\[(\text{CaCO}_3 + \text{MgCO}_3 \text{ etc.}) + 2 \text{HCl} \rightarrow (\text{CaCl}_2 + \text{MgCl}_2 \text{ etc.}) + \text{H}_2\text{O} + \text{CO}_2 \uparrow\]

During the application of the acid into the soil sample a characteristic foaming is observed, evidence of carbon dioxide’s liberation and the existence of carbonate salts consequently.

**Reagents**

**Methylorange indicator**: Dissolve 50 mg methylorange sodium salt in 100 ml H₂O, which contain 15,2 ml of HCl 0,01 N solution. Mild heat the solution, and when it gets cold an infiltration follows.

**Calcimeter Bernard filling solution**: Dissolve 200 g CaCl₂6H₂O in 100 ml distilled water, add 3 drops methylorange indicator and some drops of non-concentrated solution of hydrochloric acid till the solution becomes red-orange.

**Solution of HCl 4 N**: Dilute 340 ml concentrated HCl with distilled water up to 1000 ml.

**Instrument**

Calcimeter Bernard

**Procedure**

1. Weigh 2,00 g of prepared soil sample and transfers it into the Bernard apparatus conical flask.
2. Afterwards fill the glass of the apparatus till the ¾ of its height with HCl 4 N solution and place it into the conical flask attentively. Pay attention, that the tubule stays upright with the acid (Solution of HCl 4 N) inside.
3. Cap the conical flask with its particular plug and then zeroize the level of the filling solution. With the left hand bring the pear shaped glass container next to
the graduated column for the fluids both in the pear shaped container and in the graduated tube stand in the same level.

4. With the right hand, shake gently the conical flask, so, the HCl 4N solution comes in contact with the prepared soil sample.

5. Then CO₂ liberated. The filling solution of graduated column descends due to the pressure of liberated CO₂,

6. At the same time, we lower the pear shaped container for its fluid level to remain in the same level with the fluid of the column. This way the hydrostatic pressure equalizes.

7. When the liberation of the CO₂ is finished, stop the agitation and note the column’s reading.

In case the carbonate content is too high and the liberated gas displaces all the fluid from the graduated column repeat the process, decreasing the quantity of the prepared soil sample into 1,00 gr. Although in this case the same happens, repeat the process with 0,50 gr of prepared sample.

**Calibration**

The determination of the correction factor $f$ of the instrument is as follow:

Weigh about 0,10 g CaCO₃, which has been dried at 104°C, transfer it into the Bernard apparatus conical flask and follow the same process as described above

$$ f = \frac{W * T}{1.22 * V} $$

where:

- $W = \text{g weighted CaCO}_3$
- $T = \text{temperature of measurement, in K}$
- $V = \text{ml produced CO}_2$. 