

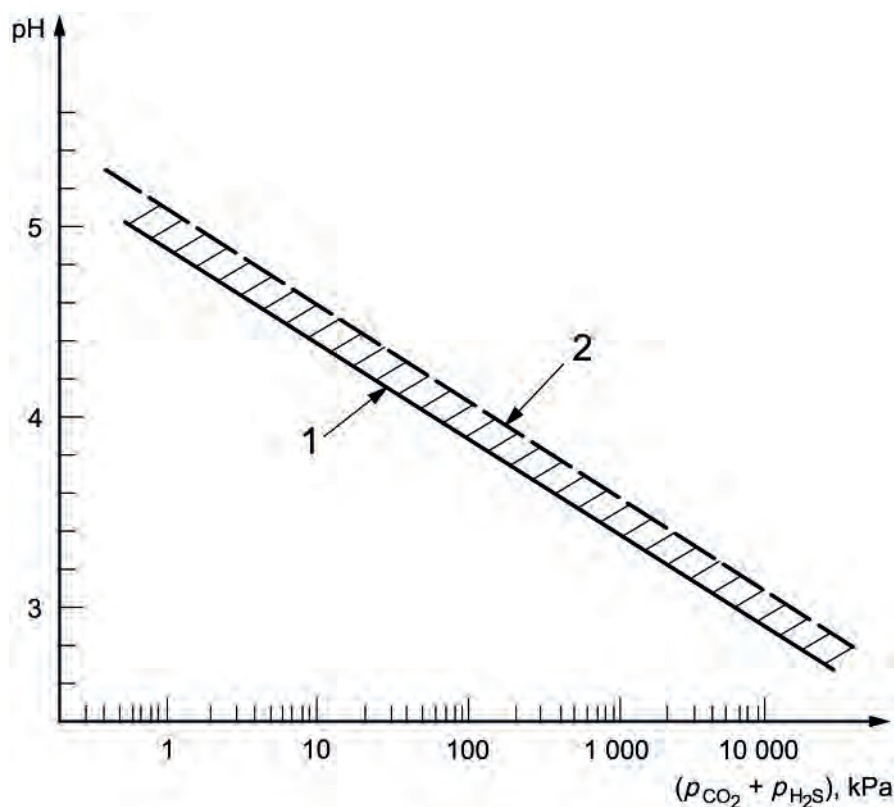
## Annex D (informative)

### Recommendations for determining pH

The use of [Figure 1](#) requires the determination of *in situ* pH for the production conditions. [Figures D.1](#) to [D.5](#) (adapted from Reference [25]) give general guidance for the determination of an approximate pH value of the water phase for various conditions. pH determined in this way may be used if no proven calculation or reliable *in situ* measuring techniques are available. The likely error band may be taken as  $^{+0,5}_0$  pH units.

In [Figures D.1](#) to [D.5](#), the ordinate axis is *in situ* pH. pH values routinely reported for depressurized water samples should not be mistaken as valid *in situ* pH values.

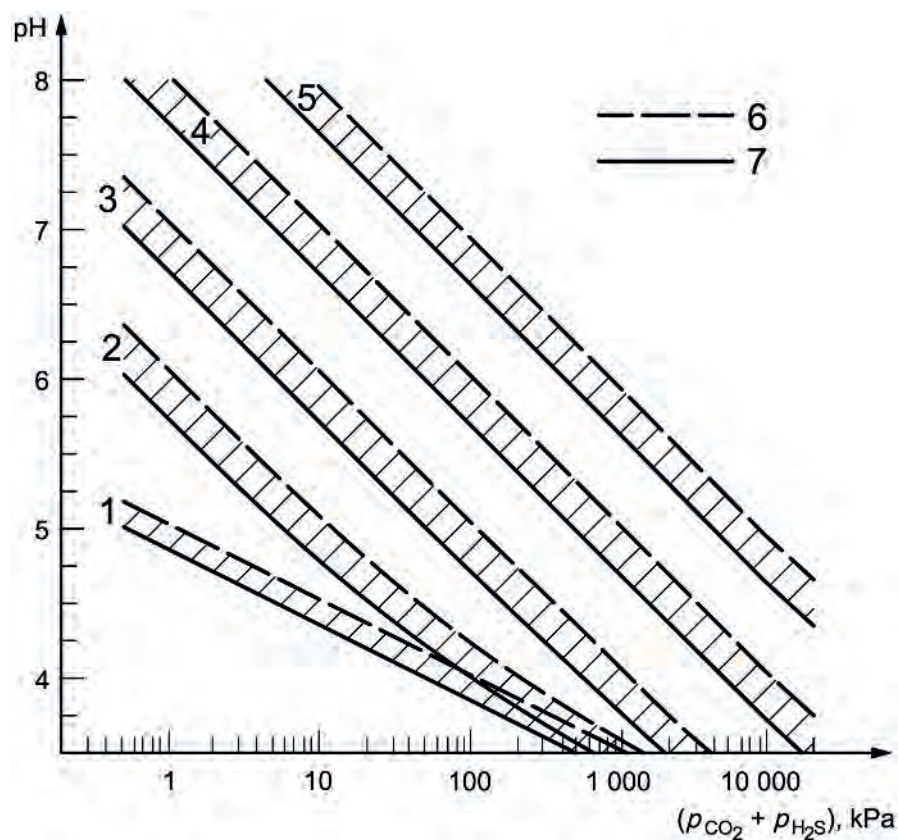
The *in situ* pH can also be influenced by the presence of organic acids, such as acetic acid, propionic acid, etc. (and their salts), that are not considered in [Figures D.1](#) to [D.5](#). The importance of the influences of these acids on *in situ* pH and on the results of conventional water analyses are described in EFC Publication 17, Appendix 2. Analysis for these components should be made in order to make the necessary adjustments to the calculated *in situ* pH.



#### Key

- 1  $T = 20\text{ °C}$
- 2  $T = 100\text{ °C}$

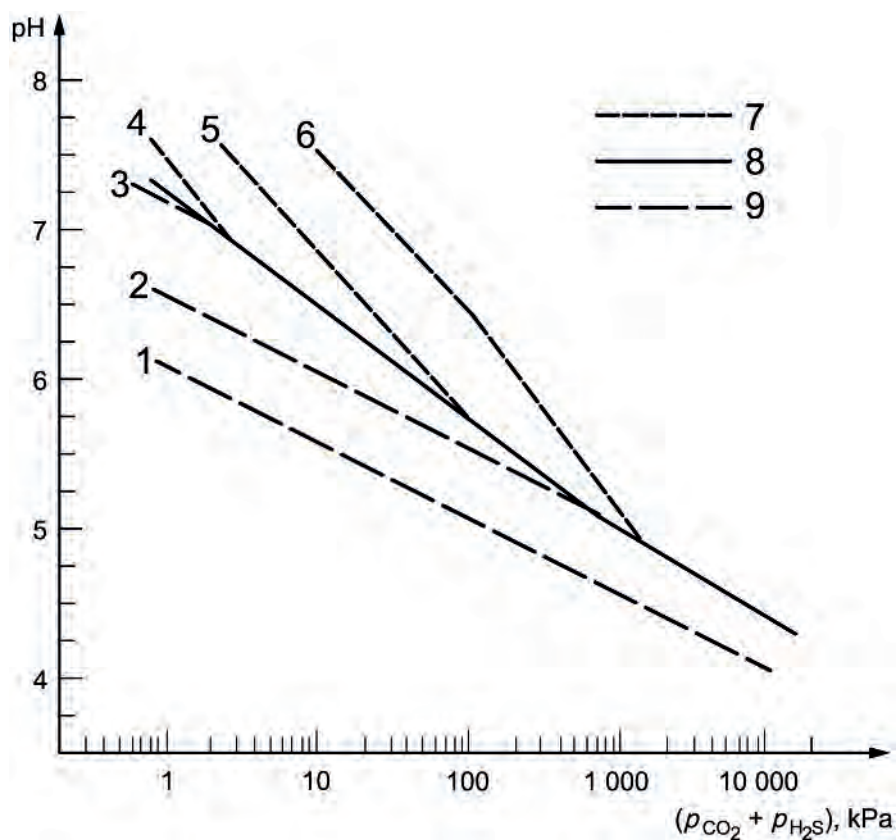
Figure D.1 — pH of condensed water under CO<sub>2</sub> and H<sub>2</sub>S pressure



**Key**

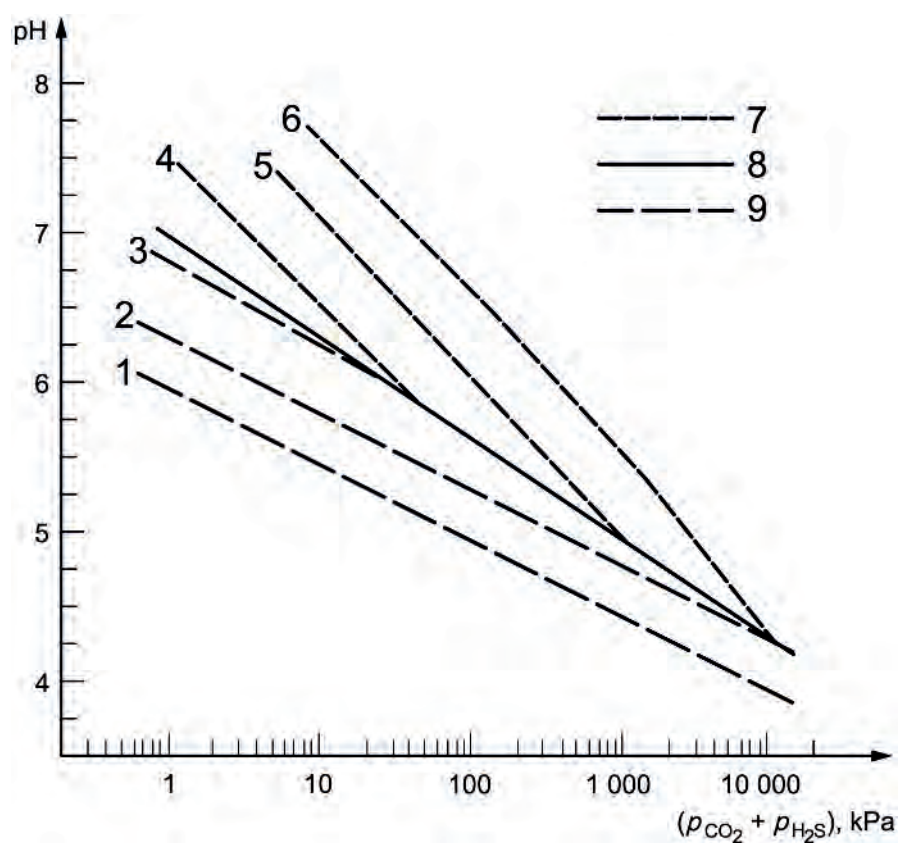
- 1  $\text{HCO}_3^- = 0 \text{ meq/l}$
- 2  $\text{HCO}_3^- = 0,1 \text{ meq/l}$
- 3  $\text{HCO}_3^- = 1 \text{ meq/l}$
- 4  $\text{HCO}_3^- = 10 \text{ meq/l}$
- 5  $\text{HCO}_3^- = 100 \text{ meq/l}$
- 6  $T = 100 \text{ }^\circ\text{C}$
- 7  $T = 20 \text{ }^\circ\text{C}$

**Figure D.2 — pH of condensate water (wet gas) or formation waters containing bicarbonate (undersaturated in  $\text{CaCO}_3$ ) under  $\text{CO}_2$  and  $\text{H}_2\text{S}$  pressure**

**Key**

- 1  $\text{Ca}^{2+} = 1\,000 \text{ meq/l}$
- 2  $\text{Ca}^{2+} = 100 \text{ meq/l}$
- 3  $\text{Ca}^{2+} = 10 \text{ meq/l}$
- 4  $\text{HCO}_3^- = 10 \text{ meq/l}$
- 5  $\text{HCO}_3^- = 30 \text{ meq/l}$
- 6  $\text{HCO}_3^- = 100 \text{ meq/l}$
- 7  $\text{Ca}^{2+} < \text{HCO}_3^-$
- 8  $\text{Ca}^{2+} = \text{HCO}_3^-$
- 9  $\text{Ca}^{2+} > \text{HCO}_3^-$

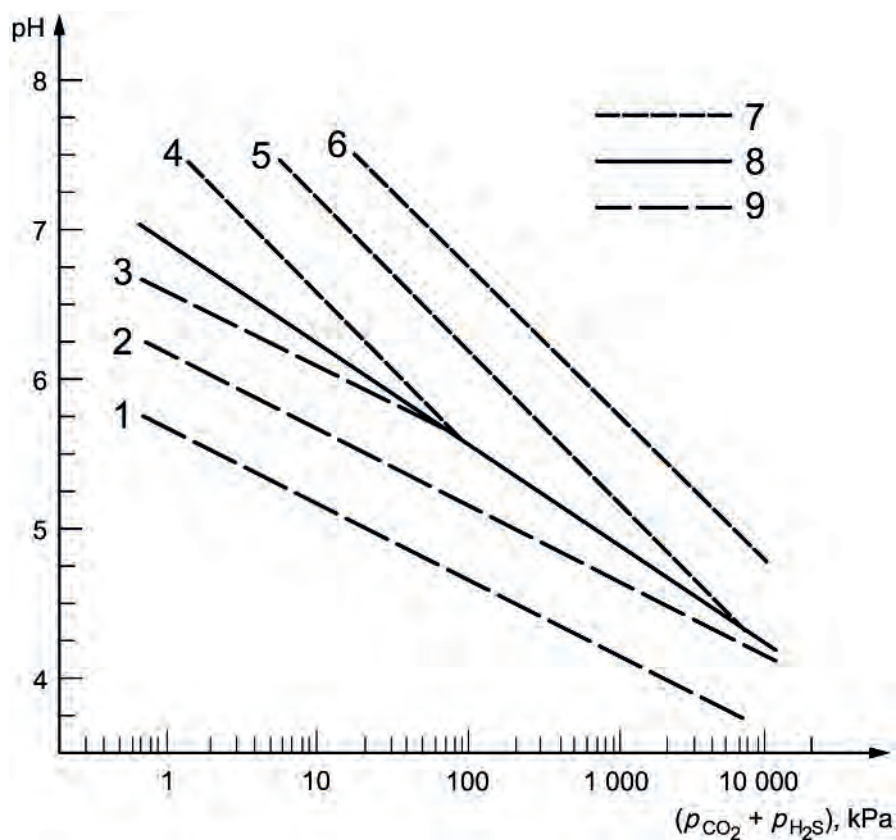
**Figure D.3 — pH of formation waters (super)saturated in  $\text{CaCO}_3$  (stoichiometric or non-stoichiometric) under  $\text{CO}_2$  and  $\text{H}_2\text{S}$  pressure at  $20^\circ\text{C}$**



**Key**

- 1  $\text{Ca}^{2+} = 1\,000 \text{ meq/l}$
- 2  $\text{Ca}^{2+} = 100 \text{ meq/l}$
- 3  $\text{Ca}^{2+} = 10 \text{ meq/l}$
- 4  $\text{HCO}_3^- = 10 \text{ meq/l}$
- 5  $\text{HCO}_3^- = 30 \text{ meq/l}$
- 6  $\text{HCO}_3^- = 100 \text{ meq/l}$
- 7  $\text{Ca}^{2+} < \text{HCO}_3^-$
- 8  $\text{Ca}^{2+} = \text{HCO}_3^-$
- 9  $\text{Ca}^{2+} > \text{HCO}_3^-$

**Figure D.4 — pH of formation waters (super)saturated in CaCO<sub>3</sub> (stoichiometric or non-stoichiometric) under CO<sub>2</sub> and H<sub>2</sub>S pressure at 60 °C**

**Key**

- 1  $\text{Ca}^{2+} = 1\,000 \text{ meq/l}$
- 2  $\text{Ca}^{2+} = 100 \text{ meq/l}$
- 3  $\text{Ca}^{2+} = 10 \text{ meq/l}$
- 4  $\text{HCO}_3^- = 10 \text{ meq/l}$
- 5  $\text{HCO}_3^- = 30 \text{ meq/l}$
- 6  $\text{HCO}_3^- = 100 \text{ meq/l}$
- 7  $\text{Ca}^{2+} < \text{HCO}_3^-$
- 8  $\text{Ca}^{2+} = \text{HCO}_3^-$
- 9  $\text{Ca}^{2+} > \text{HCO}_3^-$

**Figure D.5 — pH of formation waters (super)saturated in CaCO<sub>3</sub> (stoichiometric or non-stoichiometric) under CO<sub>2</sub> and H<sub>2</sub>S pressure at 100 °C**