Table 1: The Chemical Stages of Lime Stabilization of Soils

#	Process	Reaction	Effects	Speed
1	Hydration of quicklime (calcium oxide) to calcium hydroxide.	$CaO + H_2O \rightarrow Ca(OH)_2$	Consumes water and releases heat. Drying action for muddy soils. Required to put lime in a form that reacts with pozzolans[1].	Fairly fast Sec – Min
2	Saturation of the waters with calcium hydroxide.	$Ca(OH)_2 \rightarrow Ca^{+2}_{aq} + OH^{-1}_{aq}$	pH increases. Calcium ion becomes mobile.	Fast Seconds
3	Saturation of ion exchange sites with calcium ions.	Ca^{+2}_{aq} + Na-clay ↔ Na^{+1}_{aq} + Ca-clay	1) Ca^{+2} occupies cation sites. 2) The ionic double layer thickness decreases. 3) Water bound to clays is released from the double layers. 4) Clays coagulate and flocculate. 5) The physical properties of clay minerals change.	Fast Seconds
4	Alkaline attack on silicate minerals.	$SiO_2 + H_2O + OH^{-1}_{aq} \leftrightarrow H_3SiO_4^{-1}{}_{aq}$	Strong function of pH. See chart 1 below. pH ≥ 11.5	Moderate Min – Hrs
5	Alkaline attack on aluminous minerals to form aluminate ion.	Al^{+3}-mineral + $4OH^{-1}_{aq} \leftrightarrow Al(OH)_4^{-1}{}_{aq}$	Strong function of pH. See chart 2 below. pH ≥ 11.5	Moderate Min – Hrs
6	Polymerization of silica-complexes[2], for example: ⇒	$Si_3O_5(OH)_5^{-3}$, $Si_4O_6(OH)_6^{-2}$, etc.	Preparation for colloid and gel formation preparatory to new mineral precipitation.	Moderately fast Minutes
7	Formation of hydrous calcium alumino-silicate colloids & gel as pH stabilizes or drops due to hydroxyl consumption, for example:	$H_3SiO_4^{-1}{}_{aq} + Al(OH)_4^{-1}{}_{aq} \leftrightarrow AlSiO_2(OH)_5^{-2} + H_2O$ $x\ Ca^{+2}_{aq} + AlSiO_2(OH)_5^{-2} \leftrightarrow (Ca_xAlSiO_2(OH)_5)^{-2+2x}$	Presumably pore filling CSH-like materials.	Moderately slow Hrs – Days
8	Formation of hydrous calcium-aluminosilicate minerals, for example:	Chabazite, $CaAl_2Si_4O_{12}•6H2O$; Tobermorite, $Ca_5Si_6O_{16}(OH)_2•4(H_2O)$	Strength development	Slow Days – Weeks