

# The Benefits of Lime and Lime Additives for Soil Treatment



**Rapid Soil Drying**

**Soil Modification**

**Soil Stabilization**

**Reduced Plasticity Index**

**Reduced Moisture Absorption**

**Increased Unconfined Compressive Strength**

**Increased CBR**

**Reduced Swell Potential**

# LIME BASED MIX DESIGNS FOR VARIOUS

Soil Type	Well graded gravels and gravel-sand mixtures, little or no fines	Poorly graded gravels and gravel sand mixtures, little or no fines	Silty gravels, gravel-sand-silt mixtures	Clayey gravels, gravel-sand-clay mixtures	Well-graded sands and gravelly sands, little or no fines	Poorly graded sands and gravelly sands, little or no fines	Silty sands, sand-silt mixtures	Clayey sands, sand-clay mixtures	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
Unified Group Symbol	GW	GP	GM	GC	SW	SP	SM	SC	ML	CL
AASHTO Group Classification	A-1-a	A-1-a	A-1-b	A-1-b	A-1-b	A-1-b or A-3	A-2-4 or A-2-5	A-2-6 or A-2-7	A-4	A-6
Recommended Additives	LIME or EnviroLime (Soil Drying)						LIME or EnviroLime <sup>2</sup> (Stabilization)			
	LIME Blended with a Pozzolanic Material (Stabilization <sup>3</sup> )									

**NOTES:**

- 1) Hatched areas indicate soil classification ranges that may be less reactive with the suggested additive or not the typical "first choice" additive within that soil range.
- 2) The available oxides in EnviroLime<sup>®</sup> (Lime Kiln Dust) may fluctuate resulting in varying degrees of stabilization potential.
- 3) Geotechnical laboratory testing is highly recommended for any soil to be stabilized with any additive.

## Lime, the Proven Solution!

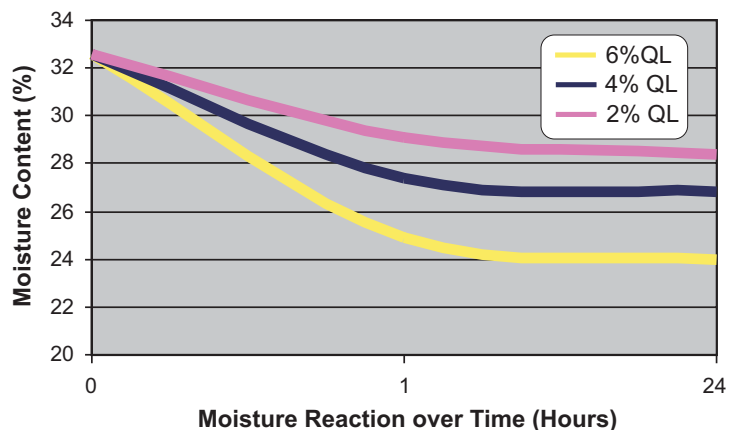


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### Will lime dry soil?

The graph below indicates a typical moisture reduction in a clayey soil. Notice that in this example 6% Quicklime (QL) was able to reduce the moisture by over 8% in less than 24 hours from approximately 32% to 24%.



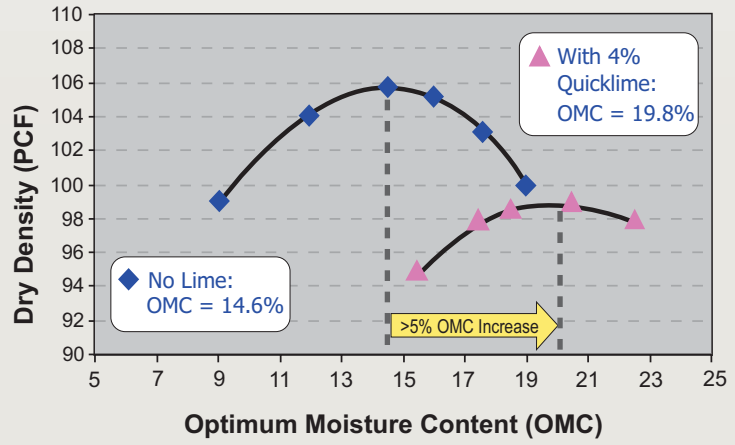
# SOIL TYPES

Organic silts and organic silty clays of low plasticity	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts	Inorganic clays of high plasticity, fat clays	Organic clays of medium to high plasticity	Peat, muck, and other highly organic soils
OL	MH	CH	OH	PT
A-4	A-5	A-7-6	A-7-5	A-8
Stabilization <sup>3</sup> & Modification				

## How does lime modify soil?

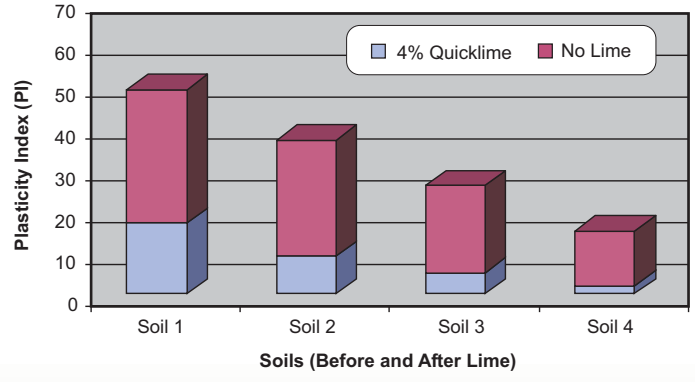
In addition to drying soil, lime will typically modify a soil by shifting the OMC curve down and to the right.

When considering quicklime's ability to both DRY and MODIFY a soil, the net effective result for this example is over a 10% reduction in drying effort to achieve maximum compaction (e.g., 5% drying and 5% increase in OMC).



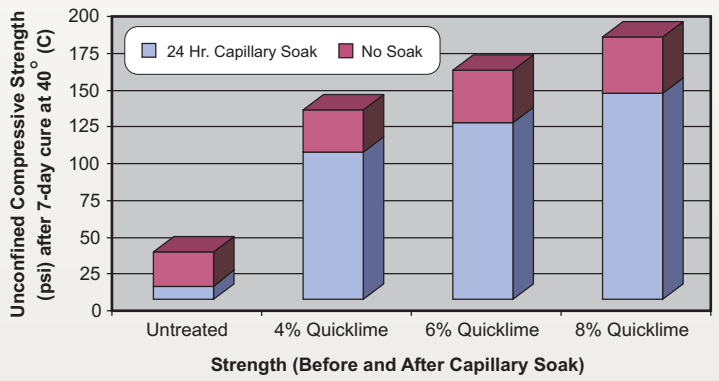
## How can lime improve site conditions?

Lime can also modify soil by dramatically lowering its plasticity index (PI), resulting in a more workable soil that has lower shrink/swell and pumping potential.



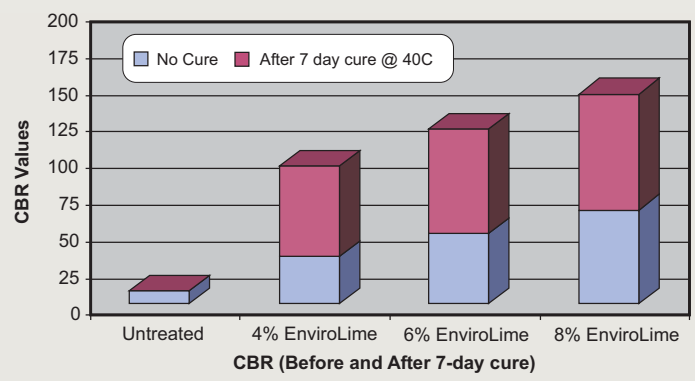
## Can lime strengthen and stabilize soil?

Lime can dramatically improve a soil's short-term and long-term strength. This graph represents how significantly the strength can be improved by adding various amounts of lime.



## Will lime improve pavement life?

Lime stabilization can significantly improve a soil's load carrying capacity, as illustrated here by improved CBR, leading to longer pavement life.



# Actual Examples Demonstrating the Benefits of Adding Lime to Soil

Location	Soil Type	Lime Treated	Treatment	OMC	PI	UCS	CBR	% Swell
Virginia	CL	Before		21	26	50 psi	2	1 %
		After	4% Quicklime	25	17	240 psi	79	0 %
West Virginia	CH	Before		21	35	10 psi	6	5 %
		After	5% Quicklime	26	19	300 psi	25	<1 %
Georgia	CL	Before		20	21	18 psi	6	2 %
		After	5% Quicklime	23	12	184 psi	61	0 %
Ohio	CL	Before		24	24	71 psi	4	2 %
		After	4% Quicklime	28	15	231 psi	52	0 %
Pennsylvania	CL-ML	Before		17	16	58 psi	3	1 %
		After	3% Quicklime	20	9	198 psi	38	0 %
Louisiana	ML	Before		24	12	39 psi	3	0 %
		After	4% Quicklime	28	9	161 psi	47	0 %
Alabama	SC	Before		15	n/a	82 psi	12	0 %
		After	5% Quicklime	17	n/a	144 psi	31	0 %

## Can lime application rates be measured?

Once a percentage of lime has been determined, the table to the right can be used to ensure the proper amount of lime is being added to the soil.

Weight of Soil (lbs./ft <sup>3</sup> )	Percent Lime	Compacted Depth (inches)					
		6	8	10	12	16	20
		(lbs./ yd <sup>2</sup> .)	(lbs./ yd <sup>2</sup> .)	(lbs./ yd <sup>2</sup> .)	(lbs./ yd <sup>2</sup> .)	(lbs./ yd <sup>2</sup> .)	(lbs./ yd <sup>2</sup> .)
100	3%	13.5	18.0	22.5	27.0	36.0	45.0
	4%	18.0	24.0	30.0	36.0	48.0	60.0
	5%	22.5	30.0	37.5	45.0	60.0	75.0
	6%	27.0	36.0	45.0	54.0	72.0	90.0
105	3%	13.8	18.4	23.0	27.5	36.7	45.9
	4%	18.9	25.2	31.5	37.8	50.4	63.0
	5%	23.6	31.5	39.4	47.3	63.0	78.8
	6%	28.4	37.8	47.3	56.7	75.6	94.5
110	3%	14.9	19.8	24.8	29.7	39.6	49.5
	4%	19.8	26.4	33.0	39.6	52.8	66.0
	5%	24.8	33.0	41.3	49.5	66.0	82.5
	6%	29.7	39.6	49.5	59.4	79.2	99.0
115	3%	15.5	20.7	25.9	31.1	41.4	51.8
	4%	20.7	27.6	34.5	41.4	55.2	69.0
	5%	25.9	34.5	43.1	51.8	69.0	86.3
	6%	31.1	41.4	51.8	62.1	82.8	103.5
120	3%	16.2	21.6	27.0	32.4	43.2	54.0
	4%	21.6	28.8	36.0	43.2	57.6	72.0
	5%	27.0	36.0	45.0	54.0	72.0	90.0
	6%	32.4	43.2	54.0	64.8	86.4	108.0



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EnviroLime® a registered brand name for name for Lime Kiln Dust (LKD), is a co-product of the lime manufacturing industry consisting of quicklime, silicates and other reactive and inert materials that make it uniquely suitable for soil stabilization, soil drying, conditioning industrial waste, remediation and agricultural use.

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The characteristics of the soil test results shown herein define common trends; however, individual test results may differ greatly due to the complex chemical and physical reactions unique to each soil. The implied warranties of merchantability and fitness for a particular purpose are expressly disclaimed. Any technical advice furnished is believed to be reliable, but Carmeuse makes no warranty regarding such advice and the user of this information releases Carmeuse from any liability arising out of the use of this information. Independent geotechnical laboratory testing is recommended to accurately understand the unique affect that lime and lime additives will have on any soil undergoing such modification.