



Optimizing Swelling Soil Mitigation Through Potassium Chemical Injection in Oklahoma

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Objectives

- Effectiveness of Potassium Chloride in mitigating problems associated with expansive soils in Oklahoma.
- Provide cost-effective alternative to traditional swell tests.
- Compare actual swell percentages obtained from laboratory measurements with water and Potassium.

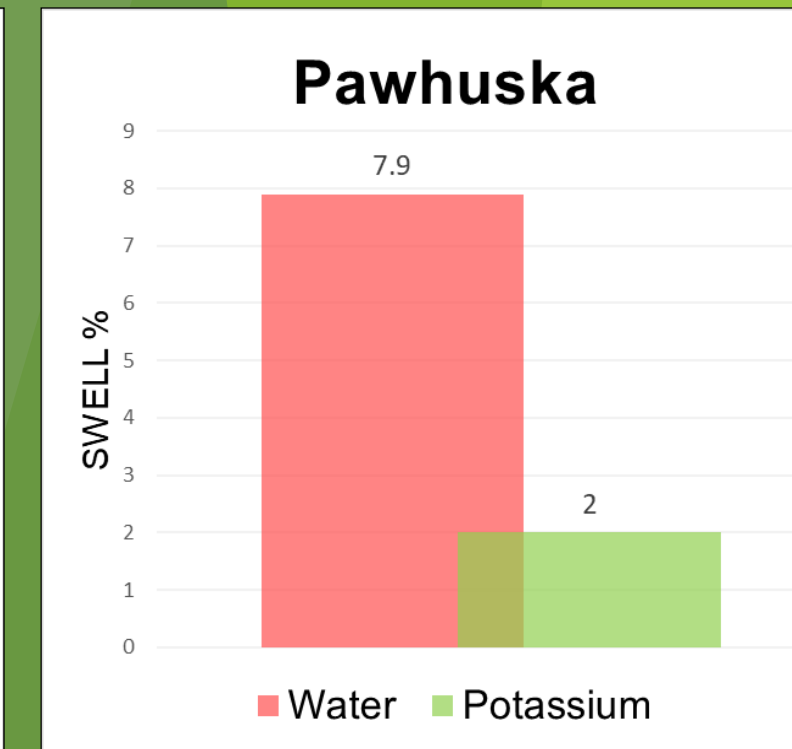
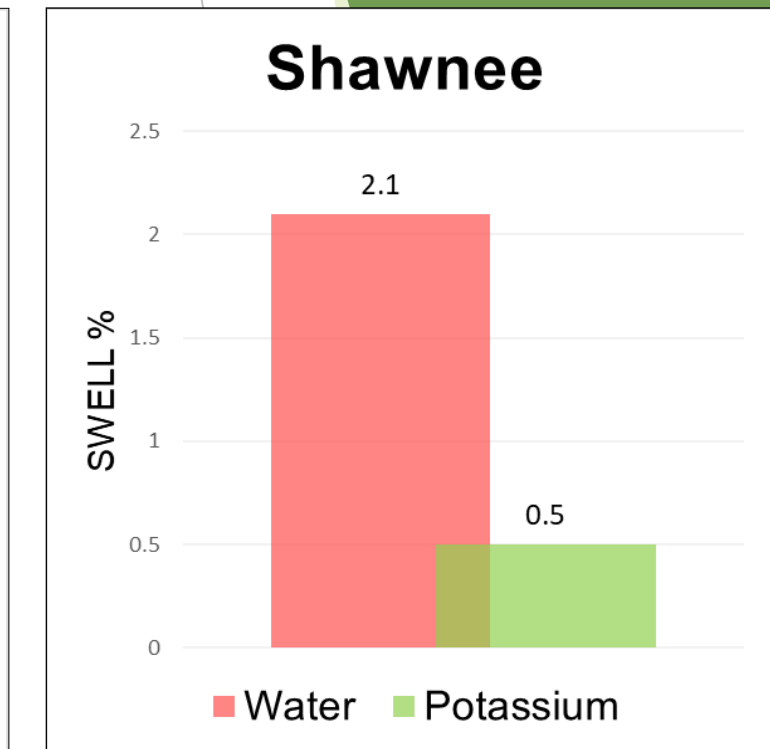
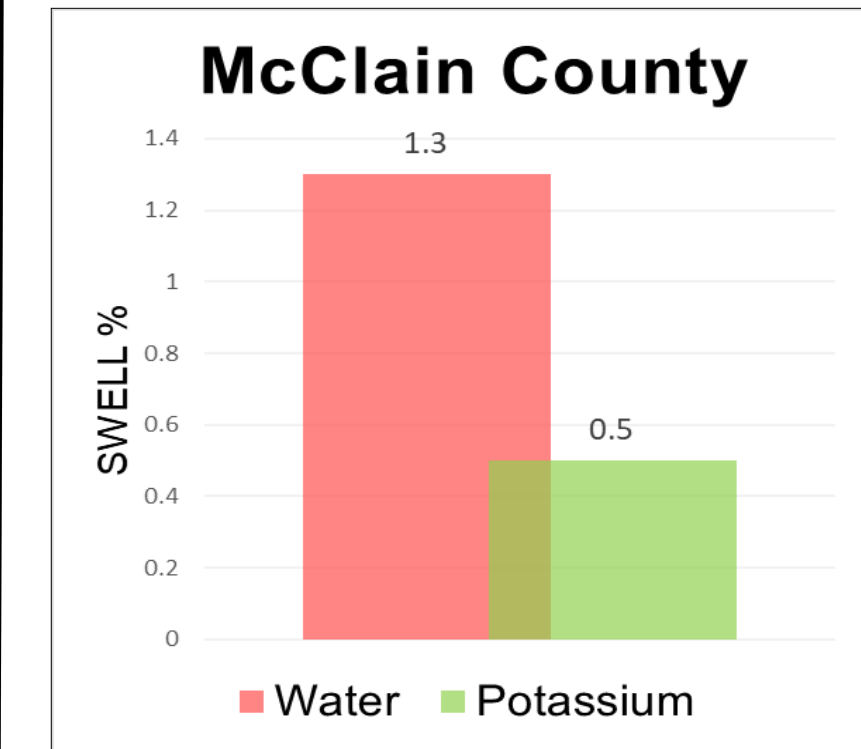
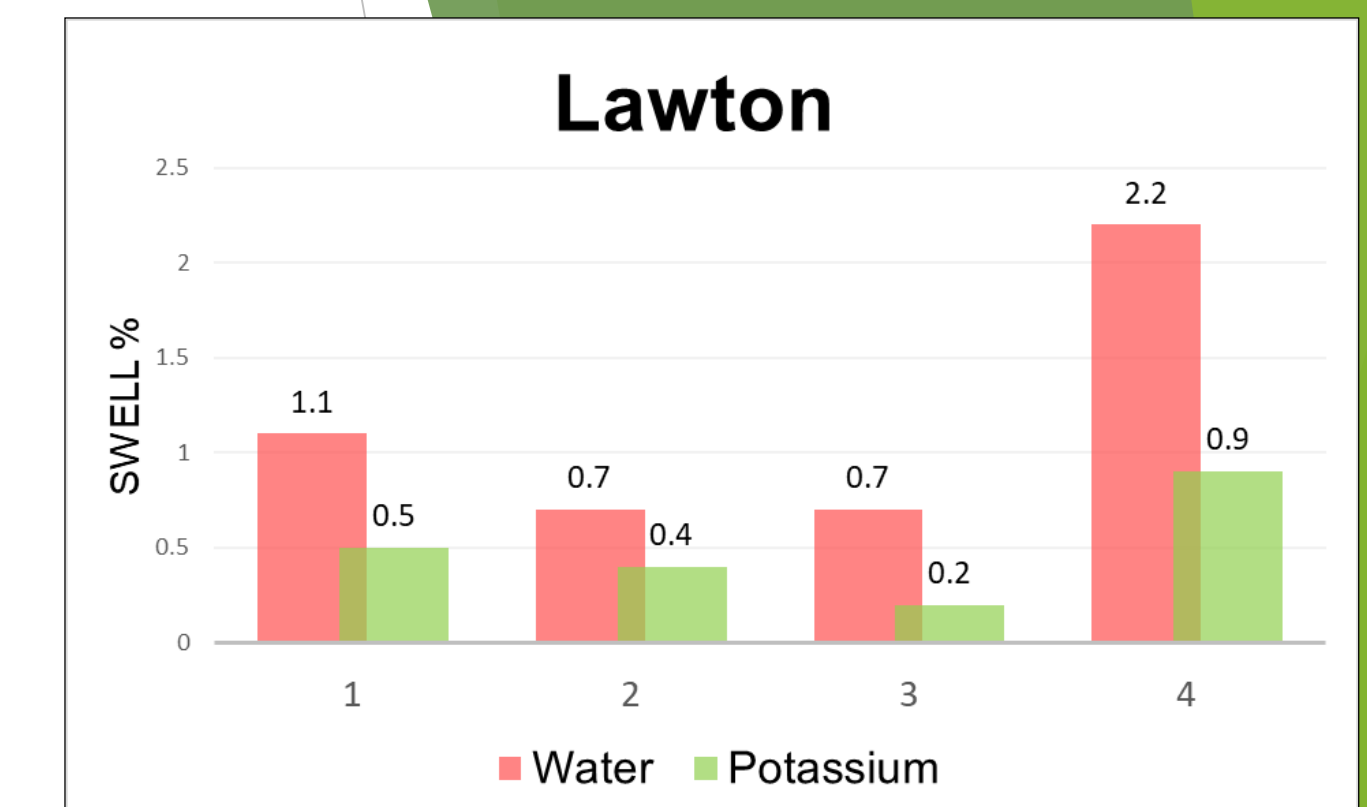
Background

- Billions of \$ spent annually to address damages caused by expansive soil.
- Using potassium to prevent swelling in expansive clay and control structural heaving is a widely-recognized technique.
- ASTM D4546, which is a 1-D test, is commonly used for determining soil swell.
- Soil samples from various locations in Oklahoma with prevalent expansive soils and associated foundation problems used in this study.

Laboratory performance test



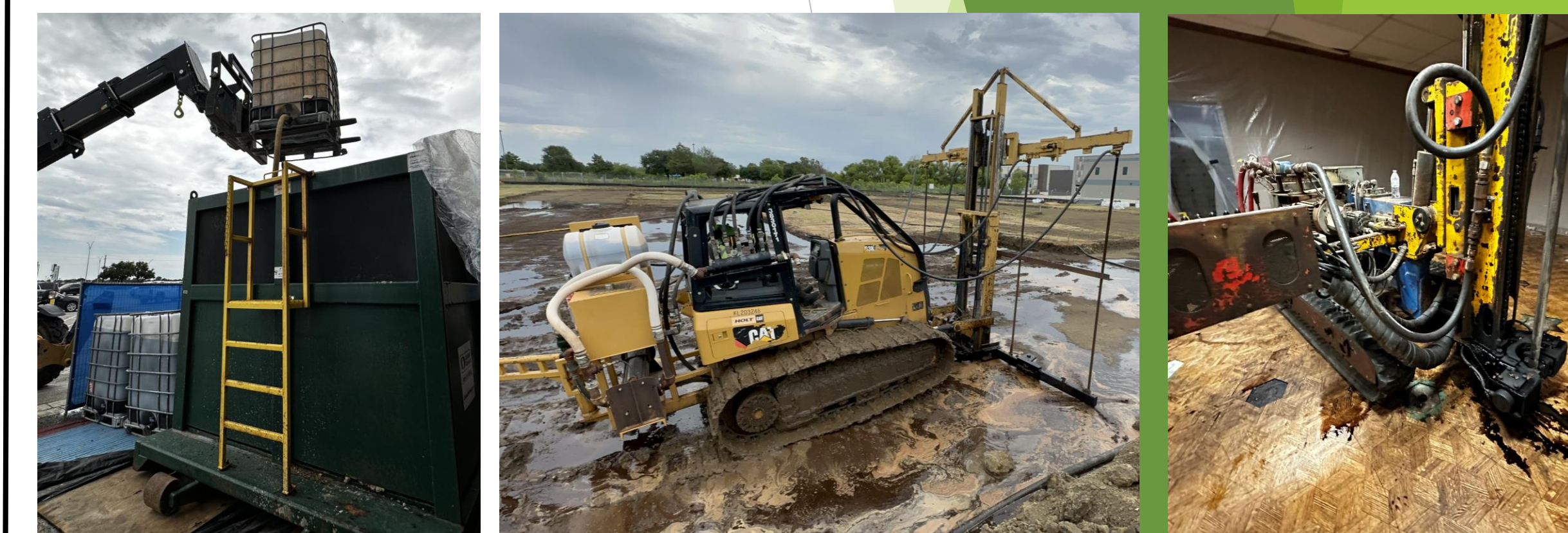
Discussions



Results from selected projects in Oklahoma

Location	Depth (ft)	Test	Natural Moisture Content (%)	Post-test Moisture Content (%)	Dry Density (pcf)	Void Ratio	Atterberg Limits			Sieve Analysis #200	Soil Class USCS	Clay Content	Overburden Pressure (PSI)	Swell (%)
							LL	PL	PI					
Lawton sample 1	3.0-5.0	Water	23.3	24.4	101.4	0.628	49	15	34	96.5	CL	53.1	1	1.1
	3.0-5.0	Potassium	20.6	22	104.1	0.583							1	0.5
Lawton sample 2	3.0-5.0	Water	21.8	23.4	102	0.629	53	15	38	95.5	CH	59.3	1	0.7
	3.0-5.0	Potassium	24.8	24.6	97.9	0.66							1	0.4
Lawton Sample 3	3.0-5.0	Water	22.4	20.6	99.2	0.602	51	16	35	90.1	CH	59.7	1	0.7
	3.0-5.0	Potassium	19.4	20.6	104.1	0.583							1	0.2
Lawton Sample 4	3.0-5.0	Water	26.8	30.7	91.8	0.802							1	2.2
	3.0-5.0	Potassium	22	20.3	102.3	0.551							1	0.9
McClain County	3.0-5.0	Water	13.2	17.5	116	0.426	35	15	20	79.1	CL	50.6	1	1.3
	3.0-5.0	Potassium	14.2	16.3	115	0.439							1	0.5
Shawnee	3.0-5.0	Water	17	21	107.2	0.544	48	16	32	95.3	CL	55.9	1	2.1
	3.0-5.0	Potassium	14	18.2	109.9	0.505							1	0.5
Pawhuska	3.0-5.0	Water	11.1	22.3	117.3	0.41	50	20	30	86.6	CH		1	7.9
	3.0-5.0	Potassium	11.1	15.8	119.1	0.389							1	2

Field Application



On-site mix design within a specialized mobile mix tank

Multi-rod unit for outdoor conditions hydraulically push the rods from zero to twenty feet

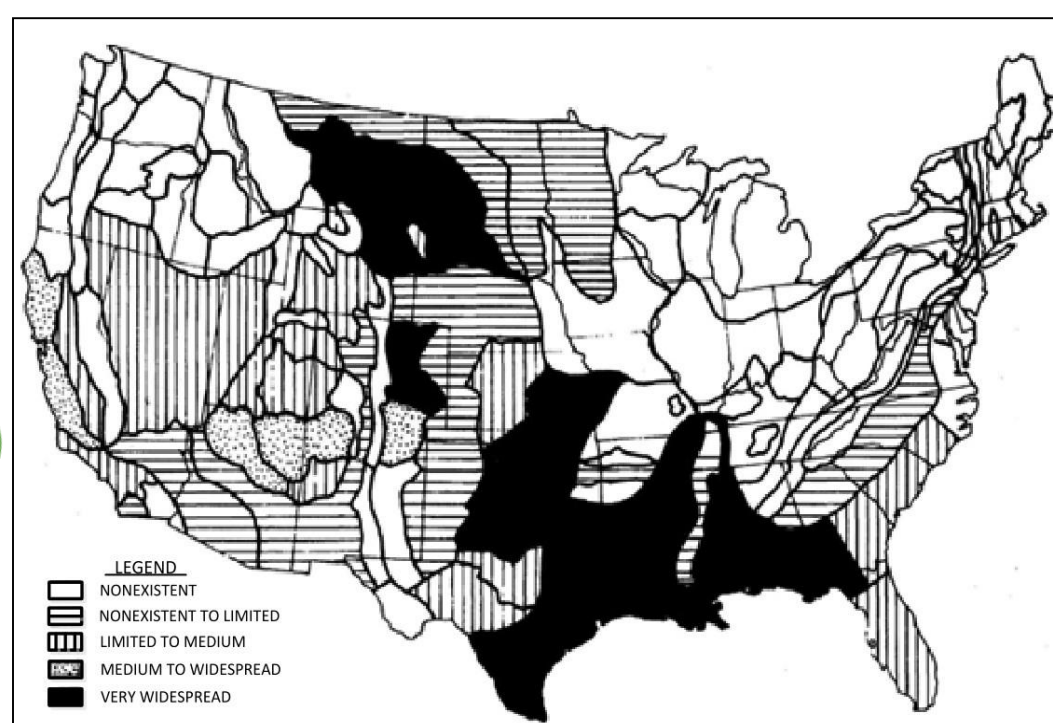
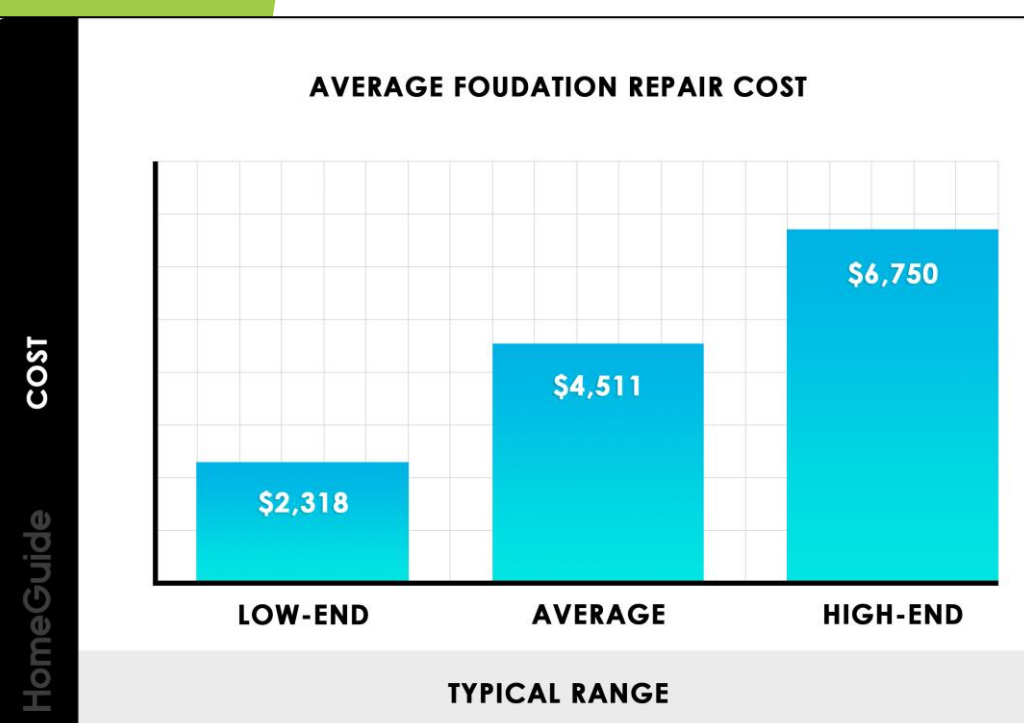
Single rod unit for indoor conditions.

Conclusions

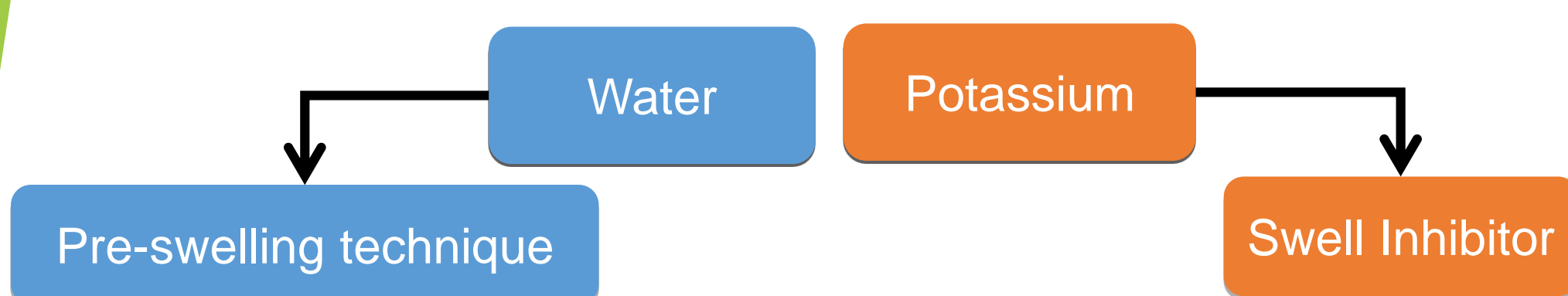
- Swell percentages values reduced significantly after potassium treatment.
- Chemical injection considered cheaper (at least 25%) than traditional methods.
- Creates opportunities for remediation exiting structures.
- Faster and less invasive stabilization method.

Acknowledgements

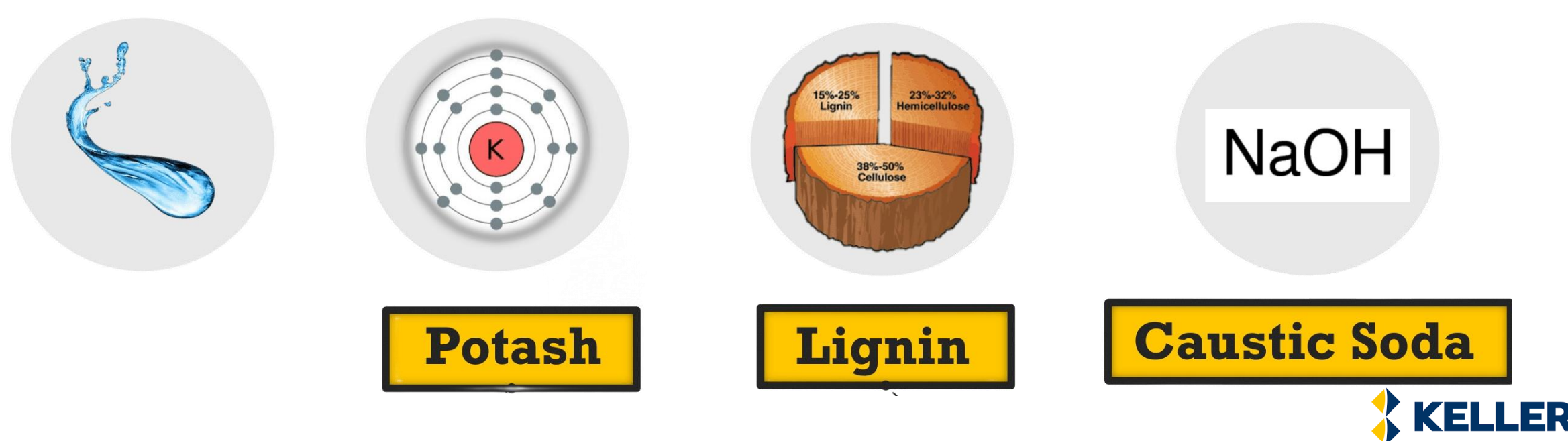
- The University of Oklahoma.
- Standard Testing and Engineering Company.
- Oklahoma Center for Advancement Science and Technology (OCAST)
- Keller North America.



Types of Injection



Potassium Injection Mix-Design



Experimental Program

- Collection of in-situ samples from different projects in Oklahoma.
- Laboratory testing in Atterberg limits (ASTM D4138), Grain size analysis (ASTM D422 and D7928), One-Dimensional swell following the ASTM D4546 Test method B.

Potassium

Water

