TYPE 1L CEMENT – WHAT WE HAVE LEARNED

TYPE 1L CEMENT BACKGROUND INFORMATION

The U.S. cement industry is transitioning from Type I and Type I/II cements to a Type 1L cement. This shift is primarily driven by environmental regulations, corporate sustainability goals, and market demands with the overall goal to lower overall CO2 emissions nationwide. It is unfortunate for our industries that these changes have been mandated to occur, but it is good for our overall environment and future sustainability. Estimates suggest that approximately 3.5 million tons of CO2 emissions were avoided in 2024 due to these changes. Many of these 1L cements are being manufactured with 8-12% limestone which is interground into the regularly produced Portland cement. Type I cement was produced with approximately 4% limestone which means the overall cement industry in the U.S. will have effectively lowered its carbon footprint by over 6%. Once all cement producers have transitioned to 1L, that would be about 5 million tons of CO2, annually, that will not be released into the atmosphere in the United States. Many of the cement producers have set a future goal at limestone content of 15%, which would mean an additional 4.1 million tons of CO2 emissions reduction. Type 1L usage is currently more than 60% nationwide and is expected to grow substantially.

While the performance of Type 1L cement is similar to Type I and I/II cements, 1L can be more sensitive to finishing and curing practices as well as water demands requiring slight adjustments in mix designs and application for best results. These differences have been well documented by ready-mix producers as well as finishing contractors. The purpose of this document is to point out the performance, setting, and finishing differences with Type 1L cement and to provide solutions and recommendations to assist in overcoming these obstacles.

WHAT ARE THE SPECIFIC DIFFERENCES OF A TYPE 1L CONCRETE MIX?

Strength

The first and main concern for many when Type IL cements were introduced was "what happens to the compressive strength?". Diluting the cement clinker would rationally result in less reactive material and therefore lower strengths. However, the cement industry responded by grinding the Type 1L cement finer, resulting in it becoming more reactive, thus alleviating the loss of reactive clinker and resulting in manufacturer reported equivalent compressive strength performance to Type I cement strengths.

RussTech has done extensive compressive strength testing in our concrete lab using local materials and have consulted with numerous customers since the introduction of Type 1L cement. Overall in-house and customer provided compressive strength results, on the Type 1L cements, have indicated no significant strength loss up to an approximate 10% reduction in compressive strengths.

RussTech customers as well as our own field and laboratory staffs have confirmed that Type 1L cement generally has a higher water demand than Type I cement due to its finer grind.

RUSSTECHNICAL NOTES

Water-Cementitious Ratio

The water-cementitious ratio is still the basis of strength and quality of concrete. It is one of the most critical influences to produce durable concrete. Maximum allowable water-cementitious ratios should *always* be employed (rather than simply adding water) to ensure strength and long-term durability. This is usually accomplished with the addition of a normal set water reducer such as **LC-400P, LC-500, or FinishEase-NC.**

Additional slumps or counteracting additional water demand can easily be addressed by using **FINISHEASE NC** or **SUPERFLO** mid-range water reducers and high-range water reducers.

Bleed Water & Set Times

We have seen a loss or delay in bleed water formation at the surface, after placement, along with some delay in set times (sometimes much longer) with most Type 1L cement mixes. The delay in set times seems to vary significantly between the different cement suppliers. The combination of these two changes means the timing window for finishing is *smaller and less forgiving*. Less bleed water and longer time of setting reduces the built-in protection against rapid surface evaporation. This can result in the surface drying out too quickly, which increases the risk of finish defects and plastic shrinkage issues. Set time delays can be counteracted by "stacking" admixtures or incorporating new special accelerating mid-range water reducers such as **LC-600L** into the concrete mix. The reduced bleed water will require tighter controls on the surface evaporation.

The stacking of admixtures has been remarkably successful with our customers. Our customers and their RussTech representative have custom-tailored mix performances to meet specific needs. Here are a few examples of admixture combinations that have exhibited positive results in overcoming specific performance issues:

ADMIXTURE STACKING	
Admixture Combinations	Description
LC-500/FINISHEASE-NC	Type A Water Reducer/ Mid-Range Water Reducer
LC-500/SUPERFLO 2000RM	Type A Water Reducer/High-Range Water Reducer
LC-400P/SUPERFLO 2000RM	Type A Water Reducer/High-Range Water Reducer
FINISHEASE NC/SUPERFLO 2000RM	Type A Water Reducer/High-Range Water Reducer
FINISHEASE-NC/LC-600L	Type A Water Reducer/Accelerating MRWR

Consult your RussTech representative for assistance with admixture stacking and dosages to assist in reducing added water demand, accelerating set time delays, and improving finishability.

RUSSTECHNICAL NOTES

Cracking & Shrinkage

There has been a great deal of discussion about a rise in cracking and shrinkage. This rise in plastic shrinkage and cracking is related to reduced bleed water, increased time of set, and untimed jointing. Since the fineness of the cement has increased for reactivity purposes, the potential for shrinkage of the cement increases. Finer cements typically will shrink more. We have seen plastic shrinkage cracking on placements with *low* evaporation rates and drying shrinkage cracking that appeared before the concrete was sawed. The solution for this is tighter execution, adequate surface evaporation control, and proper curing practices.

Finishability

It is very well known that water is the most used finishing aid, but it also *causes* the following problems:

- Decreases compressive strengths
- Decreases surface strengths and durability
- Retards the time of set
- Increases shrinkage cracking and curling
- Increases surface defects…delamination, dusting, and scaling

The big picture is that water needs to be controlled. Specifically, as noted:

- Do not exceed the *allowable* w/c ratio
- Control the amount of moisture in the aggregates
- Never add water to the concrete surface during the placement or finishing operations

VMA-758, a viscosity modifying admixture, and **FINISHEASE NC**, a multi component water reducing admixture, are two examples of integral admixtures that can be incorporated into a concrete mix design to help with finishability. Both have a proven track record of performance. **VMA-758** helps retain some of the limited bleedwater at the surface to assist in finishing while **FINISHEASE NC** provides superior workability and finishability.

WHAT SHOULD WE DO?

1. Maintain the allowable water-cementitious ratio.
2. Develop Type 1L concrete mixes that provide *normal* set times so the concrete surface is not evaporating as long with the delayed set times sometimes experienced. Discuss and develop a custom admixture system (stacking admixtures) with a RussTech representative. We have been very successful in accomplishing this. Use a surface evaporation calculator (free at RussTech website) *ahead of placement*. This will determine if there will be excessive surface moisture evaporation before the concrete sets (this is a classic definition of a drying shrinkage crack)
3. Control surface evaporation appropriately with wind breaks, sunshades, and finishing aids.
4. Concrete finishing contractors must adapt to a mix with a smaller finishing window that exhibits less bleed water. The timing of proper finishing procedures is more critical.
5. Do not add water to the surface. By adding water, you will most likely exceed the design water-cementitious ratio in the surface layer while also weakening the area where strength and durability is needed most.
6. Most Type 1L mixes exhibit reduced bleed water at the surface. Use a topical colloidal silicate finishing aid, such as **NANOFINISH**, in lieu of adding water to the mix or to the surface during finishing operations. **NANOFINISH** will: improve workability, assist in closing the surface, extend actual finish time, provide proper hydration at the surface, and will reduce callbacks.
7. Deploy proper concrete curing methods.

OUR CONCLUSIONS

Type 1L cement can be very challenging for the ready-mix concrete industry. It appears from all indications that it is here to stay, and its use will continue to broaden. Type 1L cement has been mandated to the industry and is good for our environment, and we must learn and adapt to its new characteristics. Type 1L cement is different than older Type I and Type I/II cements because of higher water demands, time of set delays and less bleed water. It will require that contractors and the ready-mix concrete suppliers work closely together with sound, practical mix designs and by implementing proper placing, finishing and curing procedures.

We should also keep in mind that the proposed plans from some cement producers to eventually increase their limestone percentages from 8%-12% to 15% may also introduce factors that may need additional attention and further discussions.

The ready-mix and its associated industries have historically been adaptive and innovative in their approaches to challenges and new technologies and this challenge is being addressed head on by all affected parties including the cement industry. Time and experience will solve these and other issues facing our industry.

Let our experienced, professional RussTech team assist you with your specific Type 1L cement performance challenges. See what experience, knowledge and *adding the difference* can do for your company. Consult a RussTech representative today.