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SAINT-ASTIER

LA CHAUX, L'EXCELLENCE POUR LA VIE

The seven powerful characteristics that make Saint-Astier NHL the superior lime binder for the most important campaigns in historic building conservation and green building:

1. **Saint-Astier NHL has lower levels of iron and alumina content as opposed to the ocher/tan (clayey) colored NHLs mostly coming from Germany, Portugal and Spain.** Higher iron and alumina content of tan NHLs may result in issues with expansion three-five years after original material installations. A delayed ettringite formation resulting from salt crystallization exacerbates expansion. The delayed ettringite formation happens when sulphates or gypsums are transported by water movement, within the wall, from capillary rise and wind driven rain. Capillary rise, coupled with a delayed ettringite formation from higher alumina containing NHLs, accelerates negative alkali-silica reactions in all wet conditions. Subsequently, any NHL with too high an alkali content (Na_2O , K_2O) in the binder is susceptible to react with the silica of the sand and/or of the stone as it is transported by water movement. This combined phenomena where there is too high of an alumina content mixed with a high alkali content will cause irreversible and unwanted material degradation when using other NHLs with these properties. With Saint-Astier NHL this does not happen and potentially damaging components or additions, such as gypsum or cement, make sulphate attack and alkali-silica reactions impossible. Existing salts in the building fabric will pass through and eventually wash off. NHLs that are tan and have higher clay components containing iron and alumina, results in the potential for future efflorescence hazards.

2. **Saint-Astier NHL yields a very appropriate amount of "Free lime" in their NHLs.** The Saint-Astier published documents state the consistent Free Lime amounts of their NHLs in full report disclosure. Other NHL producers either do not disclose the final Free Lime content because of the wide range in their product or the difficulty they have to keep Free Lime consistent enough to be a dependable range they can report on. Other NHL producers may offer a whiter colored NHL than Saint-Astier; however, even when a quarry is located within 10 km of another, the chemistry of stone can be very different. The dramatic difference can include Free Lime content. Quarries near the Saint-Astier deposit can unfortunately contain 65-88% Portlandite. This is not so with Saint-Astier NHL. Here is a more thorough explanation of "Free lime" and what is known as "Portlandite" :

Portlandite, not to be confused with "Portland Cement", is the name given to this oxide when it was first noted inside of Portland cement after its hydration. Portlandite is expressed as the naturally occurring oxide mineral form of calcium hydroxide $\text{Ca}(\text{OH})_2$ and the calcium analogue of brucite $(\text{Mg}(\text{OH})_2)$. Portlandite is sometimes as high as 65-88% in other NHLs and this is an excessive amount of what could actually be useful and beneficial.

It is called “Free lime.” Free lime (also known as ‘available lime’) is mainly the amount of calcium hydroxide remaining in the cured NHL mortar. When the appropriate amount of Free Lime is found, it is very beneficial, and it is responsible for promoting the self-healing phenomena of lime mortars. Due to its small particle size, excessive Free lime (65-88%) is responsible for increasing water demand of a lime mortar which can lead to an undesirable effect. When an NHL mortar is cured, the mortar retains the voids left behind by the evaporation of the water. When the amount of Free Lime is appropriate, it incidentally adds some air-entrainment properties that support good freeze/thaw resistance of mortars. However, if the Free Lime content is too high, the remaining pores after the mortar has cured will make the mortar act like a sponge without strength. The mortar will be observed as being ‘chalky’ in nature. Having a high capillarity and resulting absorption has proved to give the overly-breathable lime mortar the ability to allow salt crystallization. This is true especially at the juncture between the stone and the mortar which is at the heart of the issue that contributes to accelerated mortar failure. If the Free Lime content is too low, the mortar will be too dense and not breathable enough. Lime mortars that breathe poorly present new sets of internal mortar issues and adjacent material failures. An exaggerated example in mixes containing modern Ordinary Portland Cement, (OPC), the excess Portlandite which was released during hydration will crystallize, sealing up useful pores and potentially depositing calcite in the pores. Calcite is the seriously damaging, unsightly and unwanted white mineral stain left upon modern masonry work built using OPC.

Additionally, both tan and other white colored “Natural Hydraulic Limes” on the market may have a high Alite content, high Alumina content and a high Alkali content coupled with a lack of reactive silica in the natural stone deposit. These conditions may force the manufacturer to use too low of a kiln temperature to cook the limestone. Higher or lower cooking temperatures may be an attempt to control the production outcome of the natural raw material. A quarryer may use these cooking methods in order to bring the material closer to desired standards. An excessive amount of Portlandite or an excessive amount of reactive silica only forces the manufacturer to deviate from appropriate and reliable cooking temperatures. Reliable cooking temperatures can only be used on a reliable limestone deposit where the stone naturally possesses ideal qualities for making NHL if the goal is to have a uniformly consistent product to put on the marketplace. If a limestone deposit has a higher Alite content and the resulting byproduct forms tri-calcium aluminates during kiln firing, this can then lead to greater chemical shrinkage in the final analysis. Saint-Astier NHLs have a wonderful and effective range of desirable Belite and appropriate Free Lime content so their NHLs are self-healing and reliably stable for the optimal results desired regarding chemical shrinkage or expansion. These results are published on-line.

3. Saint-Astier does not alter the natural mineralogical nature of their limestone deposit. Saint-Astier does not have to manipulate the natural mineralogical properties of their raw material in order to create their very dependable and high quality NHLs. Some producers must manipulate their natural deposit. A Natural Cement producer may add calcium carbonate filler in order to hope to create an NHL 3.5 from Natural Cement. Some NHL producers may choose to add back some of their over-burnt NHL by mixing it together with their newly fired chalky limestone in order to attempt to create a material that is hoped to meet the standard of a product like Saint-Astier NHL 3.5. Saint-Astier fully disclosed the content of the mineralogy of its raw material. Saint-Astier follows through by publishing the physical and mechanical data of its NHLs in good faith. There are many products on the market called “Natural Hydraulic Lime” where a manufacturer is not fully transparent about their raw material mineralogy or the expected outcome an end-user can expect. A profound lack of transparency is more normal than not for most producers of Natural Cements, Portland Cements and Formulated Hydraulic Limes which are on the market worldwide. Saint-Astier offers full transparency on the properties of its NHL production for the world to see and for all educated engineers, architects and end-users to specify and be able to use with confidence.

4. Saint-Astier NHL is fully re-workable within 24 hours of mixing while retaining 80% of its strength. The European Norm 459 defines the properties Natural Hydraulic Lime (NHL) must adhere to in order to be called ‘Natural Hydraulic Lime’ and meet all minimum requirements of their respective classifications. In the United States the ASTM Specification C-141 recognizes Natural Hydraulic Lime and assigned it under the

name “Hydrated Hydraulic Lime” (HHL). In 2018 this American Standard requires that an HHL maintains 80% of its strength when re-worked within 24 hours of its initial mixing to meet the ASTM Standard C-141. Saint-Astier NHL meets this requirement. Most all other imported NHLs which either dry white or tan in nature, are not able to maintain 80% of their strength after being re-worked in 24 hours. This condition may be resultant of inappropriate cooking temperatures or other factors. Saint-Astier limestone by its intrinsic material nature, combined with the company’s mastered production process gives the world a superior NHL which is proved by this re-work-ability detail that out-performs most all of the competition.

5. Saint-Astier NHL 3.5 and Saint-Astier NHL 5 suffer no detrimental effects when installed in marine environments. Mixing Portland Cement or other Natural Hydraulic Limes with sea water instead of fresh water to make mortar is known to have disastrous end results. This is due to the aluminates content when it comes up against sulfates in the seawater and produces expanding salts. Some NHLs are touted to be able to be mixed with only the salty sand from a beach to make mortars with a lesser detrimental effect. However, Saint-Astier NHL 3.5 and Saint-Astier NHL 5 can be mixed directly with sea water for all marine environment installations with no detrimental effects. Saint-Astier NHL 5 will actually increase in strength over time, producing very robust repairs against the scouring abrasions of seawater in aggressive tide situations, for the marine environments of which they are placed in service. There are notable advantages for Saint-Astier NHL 3.5 and Saint-Astier NHL 5 to be able to be mixed with sea water. Fresh water can be retained for human consumption. This is very important on some islands where fresh water is a prized commodity.

6. Saint-Astier NHL pure lime and sand based mortars do not have the inherent failures of Portland cement-gauged “Type-N” and “Type-O” mortars used in historic masonry repair work. Type-N and Type-O mortars fall within the designated properties listed by ASTM and these mortar types have been successfully and extensively used in the United States for new work. Type-N and Type-O mortars often fail prematurely when repairing vintage masonry with a soft lime mortar core. For over 30 years, many masonry restoration specifications, derived from technical briefs, suggest that formulating a "soft" Type-N and Type-O “High-Lime Content Mortar”, using some percentage of Portland Cement in the binder will be suitable for making a repair and repointing mortar placed over historic soft bedding mortars. However, it is now become common knowledge by conservation professionals who are fully educated in this subject that, even the smallest amount of Portland Cement can promote the premature degradation of these inferior soft mortars that contain Portland cement when they are used to re-point or repair soft masonry units especially in exterior applications. No Portland cement is in or needs to be added to Saint-Astier NHLs to make durable, time proven and reliable lime mortars.

7. Saint-Astier is Pure and Natural Hydraulic Lime. Cement companies and Natural Cement companies produce products derived of what they possess and quarry. The consistent and dependable NHL 2, 3.5 and 5 produced by Saint-Astier need only have sand and water added to them in order to produce high quality mortars that correspond in final properties to their published results. Portland cement companies, in essence, tend to create, in dominance, a range of Portland cement products. Natural cement companies, in essence, tend to create, in dominance, a range of Natural cement products. When using formulated mixes from various manufacturers, The owner of a significant structure should be willing to accept and understand any compromise made over using dependable Saint-Astier NHLs that have the aforementioned ideal properties. Saint-Astier NHL naturally possesses indisputable and technically sound properties which are appropriate for a myriad of applications. Saint-Astier NHL is actually held as a standard for judging the quality of Natural Hydraulic Lime worldwide. The Saint-Astier company and its product have enjoyed a good reputation for 169 years and they are greatly admired by professionals in all conservation and sustainable building work. The products are within reach and readily available by a worldwide distribution network.

Saint-Astier - The natural choice when choosing excellence in an NHL