

Presentation to



Regarding

Pozzotive®



September 2, 2020

Overview



- **What Is Pozzotive®?** It is a low carbon, high-performance glass-based pozzolan that creates stronger, more durable, and longer-lasting concrete while simultaneously reducing cement-related CO₂ emissions on an almost ton-for-ton basis.
- Up to 50% of the cement used in concrete can be replaced with Pozzotive®.
- Pozzotive® provides ground-breaking solutions to problems in three industries: Recycling (unwanted glass), Cement (CO₂ emissions) and Pozzolans (shortages).
- Urban Mining Northeast (UMN) has spent more than 10 years developing, testing and gaining market acceptance for Pozzotive® which is currently in limited production at its upstate NY validation plant and is now at the point where it is commercially viable.
- UMN is preparing to meet market demand with its first full-scale production facility, scheduled to come online in September, 2020 in Connecticut with O&G Industries as its venture partner and anchor end-user of Pozzotive®.
- A national standard is now established. To ensure the broadest market acceptance of the product, UMN led a four-year process for the development of the C1866 ASTM international standard for Ground Glass Pozzolans which was published in April 2020.

Industry Problems and Solutions

Recycling Industry:

The current economics for post-consumer MRF glass are quite poor. Primary end-users are bottle manufacturers, requiring color segregation, ceramic removal, a minimum size of $\frac{3}{8}$ " and a high level of cleanliness. The closing of the Ardagh plant in Massachusetts worsened the problem in the Northeast. The green glass market is limited, and the CRT panel glass market is nonexistent. Most glass in the US is land-filled.

Solution: The Pozzotive® process utilizes any size and color of glass and ceramics, increasing both the value and utilization of recycled glass. *UMN also has a proven solution for recycled CRT panel glass, window glass and porcelain ceramic fixtures.*

Cement Industry:

The EPA estimates that a ton of cement production generates about a ton of CO₂.

Solution: The production and use of Pozzotive® as a replacement for up to 50% of cement significantly reduces related CO₂ production on an almost ton-for-ton basis.

Pozzolan Industry:

Regulations placed on coal-fired power plants along with cleaner and more cost-effective energy alternatives have caused shutdowns and conversions to natural gas, thereby reducing the supply of fly ash (a competing pozzolan). The addition of chemicals to the power plant's exhaust air is further diminishing fly ash quality.

Solution: Pozzotive® helps fill these supply voids, particularly in many metro markets where glass is readily sourced, and fly ash sells at a premium.

Major Environmental Benefits

- UMN commissioned Climate Earth to prepare a pre-production Life Cycle Assessment (LCA) of Pozzotive® based on the energy consumption of the Beacon Falls Pozzotive® plant.
- Climate Earth found that the Global Warming Potential (GWP) of Pozzotive® manufacturing is 56 kg CO₂e per ton. The GWP of the manufacture of the average portland cement is 1,040 kg CO₂e per ton. *The GWP of Pozzotive® is 5% of portland cement GWP.*
- 50% replacement of cement with Pozzotive® in a 9,000-psi concrete mix design yielded a 42% reduction in the concrete carbon footprint. The 28-day break was 9,623 psi and the 56-day break was 12,852 –an outstanding performance.

Cradle to Gate GWP (kg CO₂e) per cubic yard of a 9,000 psi mix design with and without Pozzotive®

| Material | Units | Quantity/Cubic Yard | |
|----------------------------|-------|---------------------|----------------|
| | | W/out Pozzotive | With Pozzotive |
| Type I/II Cement | lb | 850 | 425 |
| Pozzotive | lb | - | 425 |
| Sand | lb | 1,150 | 1,150 |
| Stone 1 | lb | 1,000 | 1,000 |
| Stone 2 | lb | 700 | 700 |
| Water | Gal | 34.7 | 34.7 |
| Admix1 | fl.oz | 46.8 | 46.8 |
| Admix2 | fl.oz | 17.0 | 17.0 |
| Admix3 | fl.oz | 25.5 | 25.5 |
| GWP (kg CO ₂ e) | | 625.0 | 361.0 |
| 28-day break (psi) | | | 9,623 |
| 56-day break (psi) | | | 12,852 |

The Glass Markets

- Of the 11 MM tons of bottle glass generated in the US, less than 1/3 is recycled back (primarily to bottles and fiberglass), even though 90% of consumers want recycling.
- The closing of a bottle manufacturing plant outside of Boston exacerbated the region's glass recycling challenges, causing Northeast glass to be railed to places as far as the Midwest and the Southeast for processing or to be landfilled.
- With over 260 MM tons of municipal solid waste generated a year in the US, landfilling options are becoming more costly and scarce, and the need for better solutions more pressing.
- While one ton of bottle-to-bottle recycling saves about a 1/6th of a ton of CO₂, that same ton of glass used in producing Pozzotive® will save almost one ton of CO₂ for every ton of cement it replaces! As this comparison is better understood, the concept of glass-to-concrete will be embraced even more.
- Transportation, cleaning and separation costs, coupled with cheap and easy access to virgin materials, limits the value of recycled glass to the bottle and fiberglass markets.
- Given its low market value and the impact that its weight has on trucking costs, post-consumer glass is a big problem in need of local solutions. A Pozzotive® plant that will source glass feedstock locally and serve end-users locally is one promising solution.

The Cement Industry

The production of cement requires burning limestone at high temperatures. This process consumes a large amount of fuel and, as the limestone is heated to form lime, the key component in cement, it releases CO₂ into the atmosphere. The production of portland cement accounts for approximately 6-7% of all carbon emissions annually worldwide. As such, the industry continues to seek major new initiatives to help green-out its product lines.

- Concrete is the most widely used construction material worldwide.
- The US cement market alone generates over \$10 billion in sales on about 100 million tons annually.
- The New York, New Jersey, Connecticut, and Massachusetts markets alone use about 6 million tons of portland cement per year.
- The durability, resiliency, and insulating qualities of cement-related products also lower the industry's environmental footprint. Concrete doesn't rust, rot, or burn, saving energy and resources in buildings and infrastructure.
- Because of its rigidity, concrete pavement can enhance the fuel efficiency of vehicles that travel on roads when compared to other pavements.
- *Pozzotive® can replace up to 50 percent of the portland cement in a concrete mix as a supplementary cementitious material, helping to significantly offset the cement's carbon footprint while enhancing its performance and durability.*

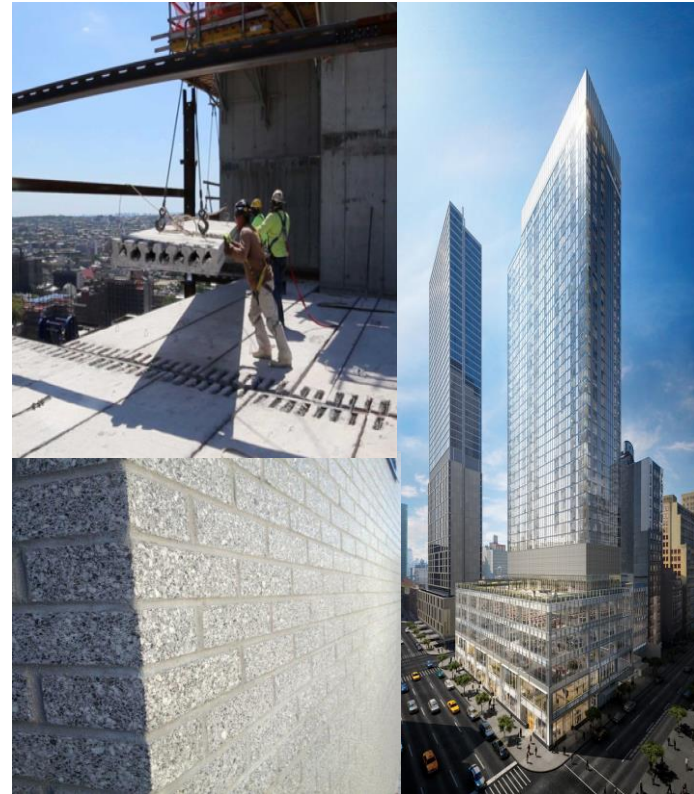
Pozzolan Markets (our end-product market)

A pozzolan is an essential component of high-performance concrete because of the unique chemical reaction that takes place in the concrete mix, imparting strength and durability to concrete products.

- The estimated use of pozzolans in the US is about 17 MM tons/year. To put the size of the market in perspective, it is more than 150% of all the waste glass generated annually.
- Approximately 1.7 million tons of pozzolans are consumed just in the Northeast US annually.
- Based on about 100 MM tons of cement used per year nationally, that represents an average cement replacement of only about 17%. Pozzotive® has proven that 50% of cement can be replaced, suggesting significant potential growth within the pozzolan sector.
- The sector includes: Fly Ash – a byproduct of coal-burning plants; Slag – a byproduct of steel manufacturing; Silica Fume – a byproduct of silicon manufacturing; Natural Pozzolans – volcanic ash, metakaolin and calcined shale.
- Due to the conversion of coal power plants, Fly Ash, the largest pozzolan in the market by far, continues to be in short supply, more inconsistent in its chemical content, and more costly, with prices in many markets exceeding cement. Other SCMs are even more costly today.
- Most are trucked or railed from distant sources. Slag, another premium pozzolan, is imported

Representative Successes To Date

- Successful third-party lab testing completed by:
 - McInnis, US Concrete, CEMEX, O&G Industries, Unilock Pavers, CCNY, Rensselaer Polytechnic Institute, Clarkson University, NYCDDC/DOT, BASF, 3M, FL and CT DOT
- Outstanding performance:
 - Sidewalks in NYC (DDC) and Mountain View, CA (Google)
 - International Pozzolan Symposium - Corona, CA (3M)
 - Over 8 million concrete blocks in place - 2nd Ave subway stations, NYPD Academy, Yankee Stadium, 855 Sixth Ave, US Navel Drone Facility, NYU, Columbia University, Sloan Kettering, University of West Virginia, UCONN, ESPN HQ, Marine Gateway (Vancouver)
 - Over 500,000 SF of pre-stressed concrete slabs in various residential developments in the NY metro area
 - Permeable Pavers – The United Nations Plaza (with Pozzotive[®] derived from the UN building window glass), Whole Foods, Brooklyn, NYCSCA Net Zero School



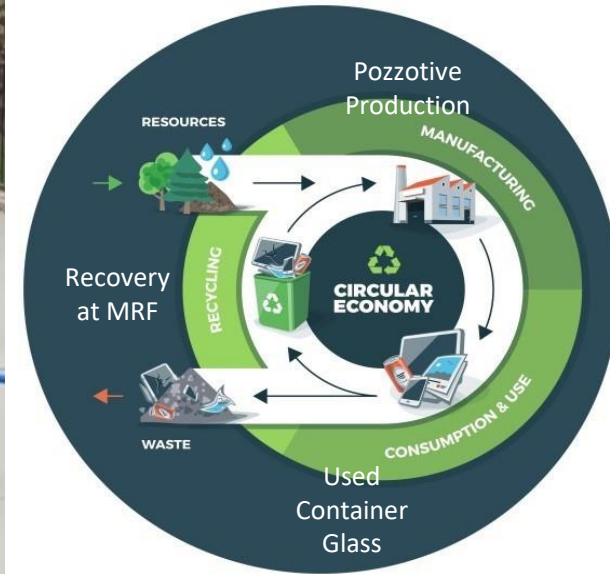
Strong Early Market Acceptance

- Pozzotive® can also transform demolition waste glass into a new building products: 60 tons of UN window glass were recovered, crushed and milled into Pozzotive® and then used to make Sustainable High-Performance Concrete pavers now at the entrance to the UN.
- Clockwise from top left: UN Plaza; National design firms already specifying Pozzotive; City Point; El Jardin de Selene, and Via Verde, all in NYC.



NYC Department of Design & Construction Sidewalk Pour

- Concrete with 20% and 40% of its cement replaced with Pozzotive[®] outperformed concrete using fly ash.
- Concrete with Pozzotive[®] is naturally lighter in color, therefore reflecting light and heat, and reducing the harmful urban “heat island” effect.
- Another perfect example of how Pozzotive[®] can contribute to a local circular economy.



Industry Turning Point

Structural high-rise residential concrete pour at Halletts Point, Queens, NY (Durst Organization, first high-rise pour nationally containing a ground glass pozzolan in structural concrete):

- Concrete was placed having an 8,000-psi design strength.
- The concrete had 35% of cement replaced with Pozzotive[®], or about 270 lbs of Pozzotive[®] per yard of concrete.
- After 56 days, the average strength of the test cylinders was measured at over 12,000 psi.
- As a result, 6,000 tons of Pozzotive[®] have been requested for the next tower.



Halletts Point

THINK
pozzotive[®]

Benefits of Pozzotive®

- A dramatic reduction in the Carbon footprint of cement
- Improved adhesion of the aggregates to the cement paste, creating a stronger concrete
- Prevention of efflorescence which is an undesirable whitish, powdery deposit on the surface of concrete
- Reduced water need, thus increasing concrete strength while maintaining workability
- Resistance to sulfate attack, a problem in coastal areas and waters containing sulfur compounds
- Extreme resistance to chloride penetration from road salts used to melt ice and snow
- A longer lasting concrete. Independent lab testing suggests that concrete with Pozzotive® may last more than five times longer than traditional concrete, offering major savings in long-term infrastructure costs
- Reduced moisture penetration which significantly suppresses the negative effects of freeze-thaw cycles
- A brighter/whiter pozzolan that can be used with white cement while also reducing heat island effect
- A pozzolan with a highly reliable chemical composition, given the consistency of the bottle feedstock used
- Pozzotive® can be manufactured locally, alleviating fly ash shortages and minimizing long-haul trucking
- The patented process to manufacture Pozzotive® utilizes any size or color glass – nothing goes to landfill
- Recovery of ferrous metals, non-ferrous metals, paper and mixed plastic, further saving landfill space
- A regionally-made product created from post-consumer glass, contributing to LEED accreditation

Recent Major New Findings

- Rapid Chloride Permeability Tests measure electrical conductivity – the lower the conductivity, the less the penetration.
- The 282 coulombs for 40% Pozzotive® compared to 1,617 coulombs for straight cement *means that if chlorides can reach reinforcement bars in 40 years in cement-only concrete, it might take over 200 years to penetrate the 40% Pozzotive® concrete.*
- This represents huge long-term savings in infrastructure costs for various municipal and state agencies, particularly where corrosion from salt is an issue.

Rapid Chloride Permeability Test (ASTM C1202)

| Concrete Mix | Coulombs |
|---------------------------------------|------------|
| Cement only | 1,617 |
| 40% of cement replaced with slag | 1,100 |
| 30% of cement replaced with fly ash | 500 |
| 20% of cement replaced with Pozzotive | 456 |
| 30% of cement replaced with Pozzotive | 436 |
| 40% of cement replaced with Pozzotive | 282 |

Study conducted by the City College of New York
Engineering Department

BuildingGreen Top 10 Products & EPA Awards

- For the past 17 years, BuildingGreen has selected ten green building products that significantly improve upon standard “business-as-usual” practices. These products reduce energy consumption and carbon emissions, improve product life cycles, and have a net-positive impact on society and the environment. Pozzotive® has now won this award twice.
- UMN also earned the United States EPA’s Environmental Quality Award in Region 2, the highest award given to the public by the USEPA.



Pozzotive Ground Glass Pozzolan



Benefits of Pozzotive® Plants to the Region

- A commercially viable and more cost-effective large-scale solution to the region's ongoing residential and commercial waste glass
- Feedstock is sourced locally, and finished products are used locally, a great environmental and community outreach story on many levels
- A better performing and much more durable concrete providing significant long-term savings in our region's infrastructure costs
- An opportunity to significantly reduce CO₂ emissions from cement production and long-distance trucking, helping to meet long-term sustainability goals
- New jobs and a significant investment in capital locally





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