LOUISIANA TECH UNIVERSITY

Trenchless Technology Center Newsletter

March 2007

Reline America Inc. Joins TTC Industry Advisory Board

The TTC is pleased to welcome Mike Burkhard, president of Reline America Inc., as an industry member of the TTC Industry Advisory Board (IAB). Reline America is a manufacturer of cured-in-place pipe (CIPP) linings using the Brandenburger UV-light curing system for the trenchless rehabilitation of sewers. The Brandenburger UV-light curing system has been developed in Germany since the 1990s and is used in many countries around the world. Reline America has a manufacturing facility in Saltville, Va. Burkhard has a long association with the trenchless technology industry in North America and we look forward to his contributions to the IAB.

NASSCO Joins TTC Industry Advisory Board

The TTC is also pleased to welcome NASSCO as an organizational member of the TTC Industry Advisory Board. NASSCO is a not-for-profit trade association established in 1976 by small number of sewer service contractors. It has expanded over the years to several hundred member firms consisting of contractors, manufacturers/suppliers and professionals (engineers, cities, etc.) involved with many technologies related to underground utility systems. NASSCO has a strong interest in many of the research and educational activities of the TTC and its guidance and input into the TTC programs will be very valuable.

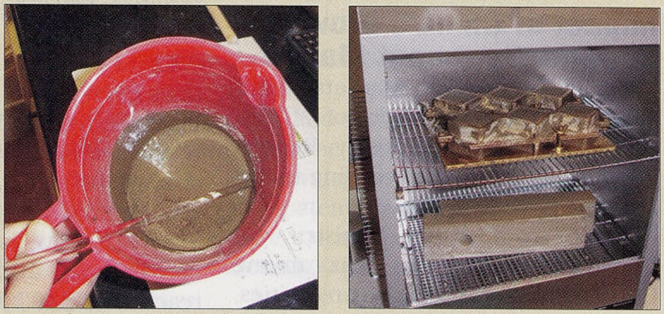
Geopolymers — An Emerging Class of Materials

Underground utility characteristics and trenchless technology methods place high demands on the materials used for pipes, liners and other underground products. One new class of high performance materials that can meet this challenge is known as Geopolymer (GP). This is an emerging, state-of-the-art material and has the potential to provide breakthrough improvements in terms of its application suitability, corrosion resistance and rapid strength gain. GPs have emerged as an interest area in various fields and in various parts of the world but are still relatively unknown in North America.

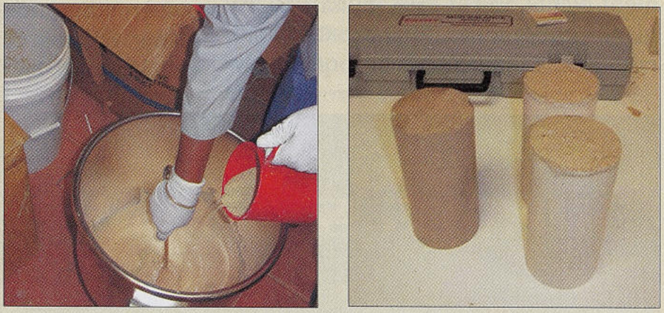
GP's result from a simple combination of a pozzolanic material (such as fly ash or metakaolin) and a high alkaline solution (usually sodium silicate mixed with a molar solution of sodium or potassium hydroxide). The hardening of GPs is due to a polymerization (unlike hydration in cements), which leads to a formation of a strong amorphous three-dimensional framework. Figures 1 and 2 show fly ash GP and metakaolin GP respectively.

Geopolymerization is a temperature-aided process and various researchers have found that an adequate curing temperature for GP ranges from 86 to 194 F. The optimum temperature depends on the raw materials used and the molar concentration of the activator solution. However, GPs are mostly manufactured at temperatures around 140 F.

GP cements (when exposed to ambient temperature) usually set within a few hours after the beginning of the reaction. However, when exposed to temperatures around 140 F, they set in approximately 10 minutes. This means that a GP mixture can have good workability at room temperature and, minutes after applying the curing temperature, it will set. The rate of the heating should be controlled to avoid an accelerated loss of moisture, which may lead to the propagation of cracks. However, if GP is cured submerged under hot water (above 140 F) curing can be faster and the loss of moisture can be avoided.



Fly Ash Geopolymer



Metakaolin Geopoymer

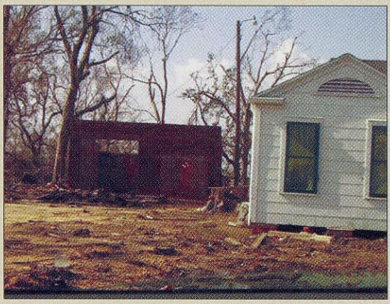
GP cements are based on silicate aluminates bonds (-Si-O-Al-O-)n with cations (Na+, K+, etc.) to balance the charge of Al3+. This peculiarity makes GPs practically inert to sulfate salts attack and gives them excellent acid resistance. GP chemistry also prevents it from the type of alkali-aggregate reaction common in Portland cement. GP also has high-temperature resistance, high-compressive strength, excellent dimensional stability and long-term durability.

All these properties make GP an excellent material for the trenchless industry whether it's used for the fabrication of pre-cast elements such as pipes and manhole components, in-situ casting of GP concrete for the repair of corroded infrastructure or spray-on coating of buried pipes and tunnels.

The TTC is actively research the application of Geopolymers in trenchless technology and buried infrastructure applications with a current team of Ph.D. students, Carlos Montes and Iván Díaz, advised by TTC associate director Dr. Erez Allouche. Inquiries about research collaborations on this innovative material are welcomed.

Understanding the Damage Caused by Hurricanes and Floods on Buried Utilities

Underground infrastructure, which is taken for granted on a daily basis, is a vital part of every urban center around the world. What many do not appreciate is that even though these structures seem relatively safe and protected by the soil, they are in fact susceptible to damage in major floods and hurricanes and the recovery of affected urban communities relies heavily on the rapid restoration of critical utility services.

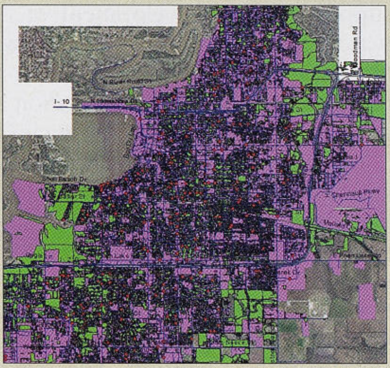


Hurricane damage in Cameron, La.

With a grant from the National Science Foundation (NSF), a team of professors and graduate students at Louisiana Tech University's Trenchless Technology Center (TTC) has been studying the impacts of hurricanes and floods on buried urban infrastructure networks for the past 15 months. The research study has focused primarily on three major events: Hurricane Katrina, Hurricane Rita and the Red River flood in 1997. The team is investigating the damages that occurred in wastewater, stormwater, potable water and gas networks.

The main goals of the study are to (1) determine the non-traditional failure mechanisms associated with flood and/or wind type events and (2) identify the necessary procedural and system design improvements associated with infrastructure networks that would lessen damage and allow rapid recovery. In order to accomplish these goals, the team acquired data by interviewing, questioning and collecting documentation from municipal engineers, private engineers and other officials responsible for repairing and restoring services in the affected communities. Utilizing geographical information system (GIS) technology, the team is currently mapping damage specific data onto city GIS shape files.

The final phase of the research study will be to analyze all of the data collected in order to identify correlations between the types of damage that occurred and the conditions that were present during the natural disasters. Drawing on the conclusions of the impact study, the TTC team will derive possible solutions to all the problems associated with post-disaster recovery planning and infrastructure network design. Exposing the weakest points in infrastructure networks during natural disasters is a critical step in preparing communities for a safer and more resilient future.



Correlating damage to storm and neighborhood characteristics using GIS.

Graduate students who have participated in the data collection are Elizabeth Chisolm, Daniel Hill and Mark Castay. The data compilation and analysis is being carried out by Elizabeth Chisolm. The principal investigator for the project is Dr. Erez Allouche. The TTC would like to thanks the many engineers and other utility personnel that have contributed their time, data and experience as part of this study. A special thanks is also due to Brad Dutruch of Compliance EnviroSystems, who have provided access to data collected in the post-disaster CCTV surveys that they have conducted.

Louisiana Tech Students Assist at the UCT Conference

Fourteen students from Louisiana Tech University traveled to Houston for the UCT conference held from Jan 29-Feb 1. The combination of undergraduate and graduate students assisted with many aspects of the conference while at the same time having an opportunity to observe the educational sessions and see first-hand the latest in equipment and techniques in the exhibition area. Student activities related to trenchless technology are organized by the Student Chapter of the North American Society for Trenchless Technology (NASTT), which is led this year by Derek Guillot, an undergraduate student in the Construction Engineering Technology program.

Trenchless Technology Center ***Newsletter***

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Trenchless Technology Center

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