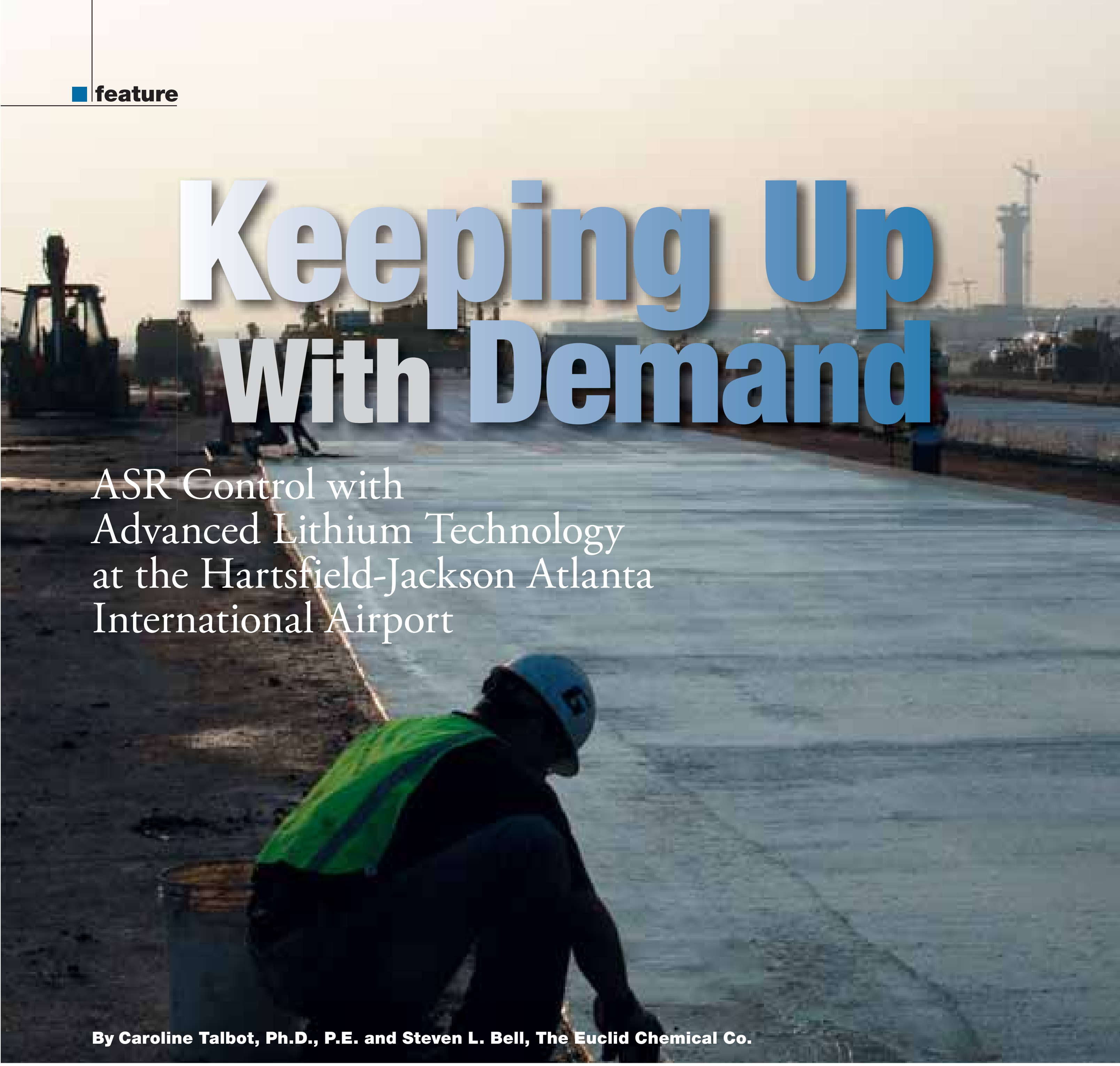

Keeping Up With Demand

ASR Control with Advanced Lithium Technology at the Hartsfield-Jackson Atlanta International Airport

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Hartsfield-Jackson Atlanta International Airport (ATL) in Atlanta is known as "the busiest airport in the world" because of passenger volume and the number of flight operations per day. Serving more than 85 million passengers in 2005 and with planes taking off and landing at a rate of two per minute, Hartsfield-Jackson must sustain a secure infrastructure. Ever-increasing demands are being placed on the facility as the Southeastern portion of the United States continues to grow in terms of both population and economic development. As a result, Hartsfield-Jackson is aggressively undertaking the modernization and expansion of the current airport facilities to accommodate its current and future traffic demands.

With increasing traffic demands, the surface areas of runways and taxiways endure great stress. Recently, cracking and spalling was reported on the deteriorating concrete of Taxiway F and Taxiway L. To address this concern, Hartsfield-Jackson authorities commissioned Accura Engineering and Consulting Services and NRMCA members FMC Corp. and the Euclid Chemical Co. to further investigate the concrete and commissioned a local construction company to reconstruct the taxiways.

The team recognized that alkali-silica reactivity (ASR) caused the deterioration on Taxiway L. ASR, commonly seen as surface cracking, spalling or pop-outs, can cause complete corrosion and shorten the life span of concrete if left untreated, signifying a

Round the clock construction was required to meet the stringent "return to service" demands necessary at the Hartsfield-Jackson Atlanta International Airport, commonly termed the busiest airport in the world.

potential risk for the airport taxiways. Additionally, if the damaged concrete was not addressed, expenses would increase as damage began to increase, posing air-traffic issues and possibly affecting airport productivity. Petrographic analysis confirmed that the root of the problem was ASR.

ASR is one of a particular class of reactions in concrete called alkali aggregate reactions (AAR). ASR is a chemical reaction that occurs between the hydration products of cement and certain siliceous rocks and minerals in the aggregate. ASR reacts in two consecutive steps. First, silica in the aggregate reacts with hydroxide and alkalis from the hydrated cement, forming silica gel. Then, the gel absorbs water, causing it to expand, and the subsequent pressure leads to cracking in the concrete. ASR typically appears in concrete five to 15 years after installation. If left untreated, the reaction continues, triggering further expansion and cracking and leaving the concrete vulnerable to complete deterioration. Once ASR has started, the reaction can only be slowed down, and a treatment can be applied to the concrete. However, ASR can be prevented by proactively using integral solutions when placing concrete. Often, ASR can be misdiagnosed because of other factors contributing to concrete atrophy, including weather conditions, marine environments, chloride corrosion and heavy stress.

Solutions for mitigating and arresting ASR vary depending on location, resource availability and budget. Solutions will often include non-reactive aggregate, lessening

With increasing traffic demands, the surface of runways and taxiways endure great stress. In addition, ASR attach further deteriorates the concrete with surface cracking, spalling, and dangerous pop-outs, requiring total slab removal and replacement.

or eliminating the potential for reactivity. However, non-reactive aggregates are diminishing or are unavailable in certain areas and contingent on project location; shipping the aggregate considerable distances is not logistically ideal or economical.

Reducing the alkali in cement may help mitigate ASR, but the higher the level of aggregate reactivity, the less effective ASR suppression is. Low-alkali cement is becoming increasingly expensive, increases energy consumption for cement manufacturing and may result in the production of environmental waste. Natural pozzolans can be effective, but their availability is scarce throughout the United States.

Hypothetical Concrete Examples for Airport Pavement in the Southwest

ASTM RESULTS FOR ASR MITIGATION OPTIONS	Option 1	Option 2	Option 3
	Non-Reactive Aggregate	Reactive Local Aggregate with 30% Suitable Pozzolan	Reactive Local Affregate with 25% Suitable Pozzolan plus Eucon Integral ARC
ASTM C-1260 Coarse Aggregate Expansion0.04	0.15	0.15	
ASTM C-1260 Fine Aggregate Expansion	0.05	0.23	0.23
ASTM C-1567 Coarse Aggregate & 30% Class F Fly Ash		0.07	0.07
ASTM C-1567 Fine Aggregate & 30% Class F Fly Ash		0.15	0.15
ASTM C-1567 Coarse Aggregate & 25% Class F Fly Ash + 50% Lithium Dose			0.04
ASTM C-1567 Fine Aggregate & 25% Class F Fly Ash + 50% Lithium Dose			0.07

MATERIAL COSTS	Quantity in Lbs.	Unit Cost per Ton	Cost/Cu. Yd. incl. Transportation(1)	Quantity in Lbs.	Unit Cost per Ton	Cost/Cu. Yd. incl. Transportation(1)	Quantity in Lbs.	Unit Cost per Ton	Cost/Cu. Yd. incl. Transportation(1)
ir	611	$88.00	$26.88	428	$88.00	$18.82	458	$88.00	$20.16
Class F Fly Ash (low CaO%)	n/a	n/a	n/a	183	$65.00	$5.96	153	$65.00	$4.96
Coarse Aggregate	1890	$7.50	$22.21	1890	$7.50	$10.87	1890	$7.50	$10.87
Sand	1550	$6.25	$17.24	1550	$6.25	$7.94	1550	$6.25	$7.94
"Admixtures, etc."	n/a	n/a	$0.50	n/a	n/a	$1.00	n/a	n/a	$1.00
Eucon Integral ARC (per gallon)	n/a	n/a		n/a	n/a		0.63	$15.00	$9.45
Material Waste Percentage	2.50%		$1.67	2.50%		$1.11	2.50%		$1.12
Sub Total – Materials			$68.50			$45.70			$55.50
ADDITIONAL COSTS (Assumed)									
Interest on Money 90 Day Pay/6.0% per Annum			$1.03			$0.69			$0.83
Operating Costs Plus Handling Separate Aggregate Piles			$3.50			$3.00			$3.00
Concrete Delivery Cost for 20 Mile Round Trip to Job Site			$4.00			$4.00			$4.00
Fixed/Capital Costs			$20.00			$21.00(2)			$21.00(2)
Sub Total Additional Costs			$28.53			$28.69			$28.83
Total Cost/Cu. Yd.			$97.03			$74.39			$84.34
Solution Option Viability		**VIABLE**			**NON-VIABLE (Due to Reactive Rock)**			**VIABLE**	

1 Transport Cost	Option 1	Option 2 & 3	2 + New Silo for Fly Ash
Ton Per mile	$0.20	$0.20	
Mile Round Trip	80	20	