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Maintaining Airport Pavement Friction Using Surface Densification

A Sustainable Pavement Asset Preservation Tool

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Introduction

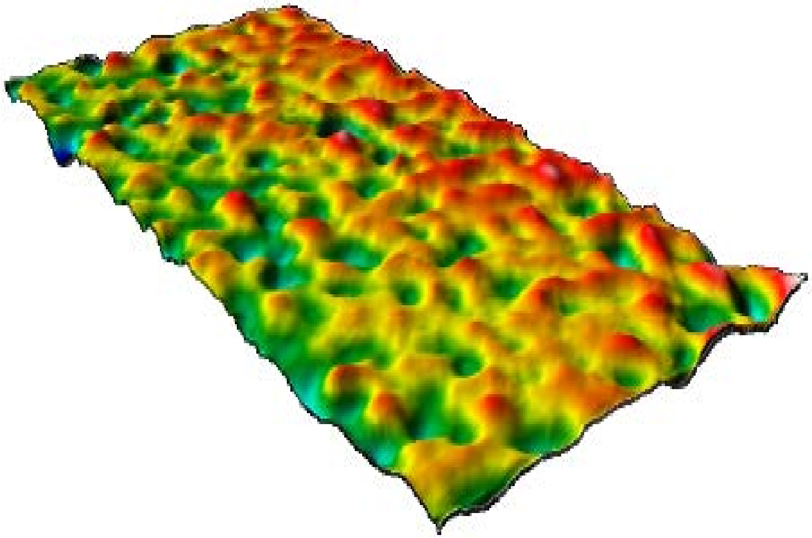
- Pavement structures are an airport's "greatest asset and greatest liability"

- Pavement preservation to:
  1. enhance safety
  2. reduce operational disturbance

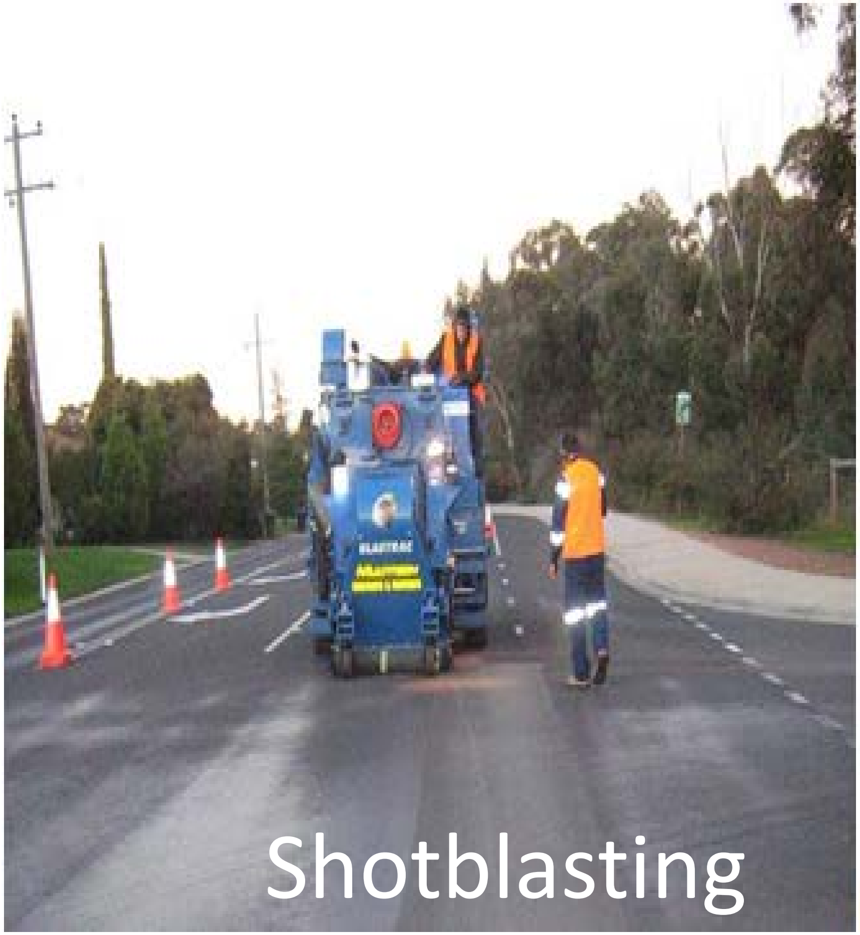
- Including cost of disrupted operations in decision-making algorithm can make a treatment that is marginally more costly a bargain if
  1. extends the service life of the pavement
  2. extends the time between maintenance disruptions

Concrete Densification

- "Densify": a chemical process where a reaction between a surface treatment's hardening agent and the concrete creates a denser surface texture, which is harder than plain concrete in the near-surface region.
- Lithium silicate is a common, reliable agent to harden the surface of Portland cement concrete (Nasvik, 2013).



Densifier Over Shotblasting (DOS)



Objective

Explore an underutilized asphalt and concrete pavement preservation tool ~ DOS ~ used on new/existing pavements (runways, taxiways and aprons) to:

- harden against abrasion
- minimize FOD potential
- reduce permeability/degradation from deicing solutions
- restore skid resistance lost to both snowplowing and rubber accumulation

on the basis of *cost effectiveness.*

Methodology

LCCA input data from DIA case study in ACRP Synthesis 11:

- EUAC for 1 of its 12,000 foot runways
- 4 surface treatment alternatives considered
- Each alternative's life cycle starts with a hypothetical 10 inch (25.4 cm) unbounded PCC overlay which provides a newly constructed surface and the option to either use a standard or lithium-based cure.

Methodology

4 alternatives considered:

1. Standard cure and resurfacing/regrooving uses no lithium-based products.

2. Standard cure and lithium densifier applied over shotblasting (DOS) at every resurfacing/regrooving.

3. Standard cure and lithium densifier applied over light diamond grinding (DODG) at every resurfacing/regrooving.

4. Lithium cure and lithium densifier applied over shotblasting (DOS) at every resurfacing/regrooving to harden the runway surface and preserve the grooving.

Methodology

- CA study on a PCCP field test site: DOS reduced rutting by ~50% versus control (Haworth 2011).
- A typical grooved concrete runway at the JFK International Airport is scheduled for resurfacing (shoulder/erosion/fillets seal coat/PCC repairs/regrooving) once every 8 years (ARA 2011).
- Tulsa International Airport used a 6 year maintenance cycle to rout and seal the joints on its PCCP runway (ARA 2011) LCCA.

~Hence, a 50% reduction in surface loss would equate in the need to resurface once every 12 years.

~Assumption (conservative): only 2 years of extended service life is realized in the LCCA calculations to follow.

Methodology – Input Values

- DIA's air traffic volume:
  - average of 36 operations per hour
  - $40 per minute per plane delay cost
  - translates to delay cost $86,400 per hour total.
- Most scheduled maintenance work is conducted at night to minimize operational impact:
  - 25% ($21,600/hour) delay cost will be used on each alternatives
- ACRP Synthesis 11:
  - average 7 hours per night full runway shut-down for rubber removal
  - DOS = 3,200 SY/hr; other treatments = 2,000 SY/hr
- One DIA runway:
  - 12,000 feet long and 150 feet wide
  - Each alternative evaluated over three complete maintenance cycles
- Equivalent uniform annual life cycle cost will be used because the alternatives have different service lives

LCCA Input

Table 1 Construction Cost Input Data

Alternative	Input Cost Data		
	Low	Likely	High
10" PCC Overlay	$11,700,000	$11,700,000	$11,700,000
Standard	$642,400	$1,079,900	$1,642,400
DOS at resurfacing	$590,400	$851,400	$1,166,400
DODG at resurfacing	$858,400	$1,354,400	$1,984,400
Lithium cure +DOS at resurfacing	$660,400	$926,900	$1,292,000

LCCA Output

Table 2 Life cycle Cost Analysis Output.

Alternative	Service Life	Deterministic Annual Life Cycle Cost			Stochastic Annual Life Cycle Cost		
		Low	Likely	High	10%	50%	90%
Standard	18	$801,113	$856,041	$926,663	$842,174	$860,918	$880,843
DOS at resurfacing	24	$731,825	$758,696	$791,127	$762,562	$772,098	$781,800
DODG at resurfacing	24	$742,444	$770,250	$803,809	$809,826	$828,375	$847,564
Lithium cure + DOS at resurfacing	26	$770,996	$823,837	$890,954	$751,350	$760,524	$769,801

To Note

- Analysis, while realistic and pragmatic, is hypothetical and meant only to demonstrate the promise that these products embody for airport pavement preservation.
- Recommend that rigorous full-scale field testing be conducted as future research to replace the assumptions that had to be made to complete the analysis.
- As the world's air traffic continues to grow, airport pavement managers will come under more pressure to maintain the required level of service with increasingly fewer mandatory maintenance and repair disruptions to the flow of airplanes and passengers.
- Lithium densification and curing compound must be rigorously tested to permit the industry to adopt it as a new tool in the pavement preservation toolbox.

Conclusions

- There is potential benefit to adopting lithium-based treatments (DOS) as an airport pavement preservation tool.
- DOS can extend the life of concrete runways by making them more wear resistant and is both technical and financially viable.
- DOS enhances operational sustainability by reducing the number of times in a runway pavement's service life where it must be fully closed and disrupt airport operations.

Thanks!

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