A COMPREHENSIVE APPROACH TO GRAVEL RUNWAY SURFACE MAINTENANCE

Presented by:
Chett Siefring, P.E.

SWIFT 2014

September 18, 2014

MIDWEST

Typical Gravel Runway Maintenance Program

- Construct/Rework runway
- Visual observations to determine when maintenance work is required
- Perform runway maintenance to address rutting, raveling, potholing, dust levels and gravel loss

Midwest's Comprehensive Approach

- Develop a comprehensive program to protect the investment in the runway and preserve the as-constructed condition
- Use of products that will facilitate FINES PRESERVATION on runway surfaces
- Pre-construction/rework lab testing on surface soils to determine the product and application rate to achieve the desired goals
- Construct/Rework runway
- Apply fines preservation product
- Collect data pre and post product application (yearly schedule)
- Use data to predict when runway performance will fall below acceptable ranges, indicating when additional product and maintenance would be required
- Project Management expertise

MIDWEST

Why a Comprehensive Approach?

- Need to preserve the investment made to construct/rework gravel runways
- Ensure $$$ are being spent that maximize runway performance.
- Reduce the maintenance cost by up to 50% over strategies that do not include the use of products
- Allows for extended life of runway surface with minimal re-working of surface – saves time and money, equipment and airplane wear and tear and runway performance
- Runway performance measured with data in addition to visual observations. Data provides an indicator as to how well the runway is holding up and can help predict when additional product will be required
- The use of fines preservation to eliminate rutting, potholing and raveling that result when fines are lost from the runway surface. That leads to a reduction in gravel replacement and resurfacing costs
- Selection of products that are environmentally friendly
- Better grip for takeoffs and landings
- Project management expertise

Comprehensive Approach Method - Step 1

- Determine the desired outcomes of the runway.
  - Strength requirements
  - Dust level reduction
  - Reduction in airplane damage
  - Reduction in maintenance cost
  - Improved safety
  - Improved air quality for local communities - reduction in respiratory diseases
  - All of the above

Comprehensive Approach – Step 2

- Selection of surface material, construction method and product to achieve desired outcomes.

Comprehensive Approach – Step 2 cont.

- Selection of construction/rework method:
  - Full depth rework – expensive and time consuming
  - Surface layer rework – top 6-inches – time consuming and potentially expensive
  - Surface rework – top 2-inches – quick and inexpensive

Comprehensive Approach – Step 2 cont.

- Selection of soils for use:
  - Imported materials – expensive
  - Use of on-site materials – may not be best to construct with – less expensive and available
  - Soils submitted for laboratory design testing
    - Classification with moisture content
    - Proctor test
    - CBR test

MIDWEST

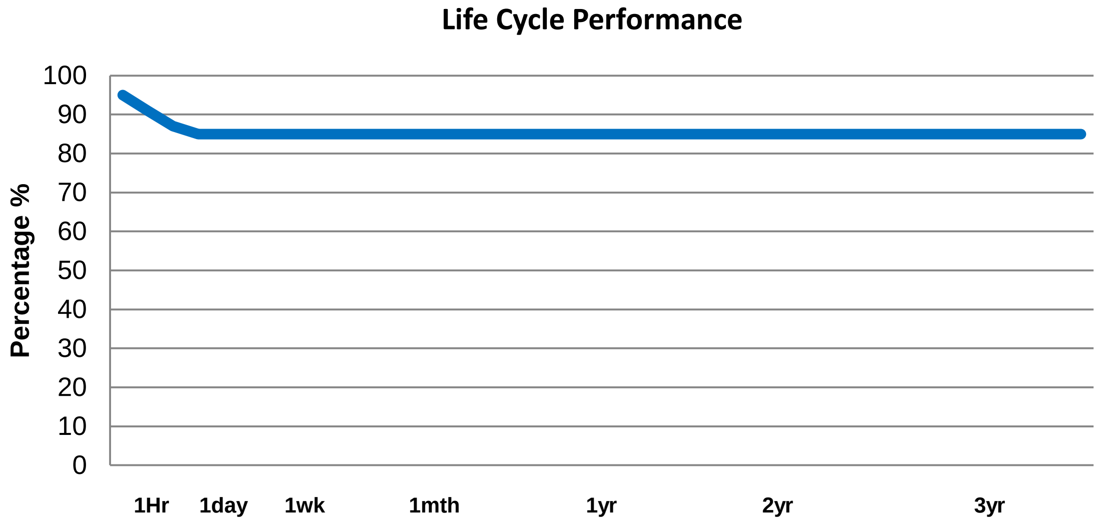
Comprehensive Approach – Step 2 cont.

- Product Selection – Performance
  - Safe for aircraft surface - meets Boeing requirements (Boeing Document D6-17487) for Sandwich Corrosion (ASTM F1110-90), Acrylic Crazing (ASTM F484-83, using Type C acrylic), Paint Softening (ASTM F502) and Hydrogen Embrittlement (ASTM F519) tests
  - Selection based on fines preservation with dust control
  - Pre-performance certification – treated soils achieve minimum CBR values as specified by requesting agency

MIDWEST

Fines Preservation

- **Fines Preservation – so much more than dust control**
  - Long-term effectiveness ranging from 1 to 3 years when the comprehensive maintenance program is followed
  - Gravel and fines are not lost
  - "As-constructed" design and profile are substantially retained
  - Maintenance costs are reduced over life cycle as a result of reduced potholes, rutting and raveling
  - Dust control



Why is Fines Preservation Important?

- Gravel runways are subjected to periods of intense daily traffic and heavy loads
- Fines are the "glue" that binds the runway surface together and forms the durable surface layer
- A loss of fines increases the degradation rate of the runway surface through potholing, rutting and raveling, resulting in:
  - Increased wear on planes
  - Increase damage to planes as a result of FOD
  - Unsafe conditions
  - Increase in dust levels
  - Increased cost to maintain the integrity of runway surface
  - Air quality issues for nearby communities

MIDWEST

Comprehensive Approach – Step 2 cont.

- Product selection- Environmental Considerations:
  - Synthetic fluid with binder
  - Binder must demonstrate flexibility and elastic recovery
  - 100% active
  - Applied neat to soil surface
  - Is not water soluble or dilutable
  - Does not evaporate or volatilize from surface
  - Performance of applied product must not be negatively affected by freeze/thaw cycles
  - Cannot be classified as RCRA waste product
  - Meet US EPA requirements for VOC, SVOC, Metals, Mercury, Toxicity Characteristic Leaching Procedure (TCLP) and Aquatic Toxicity

MIDWEST

Comprehensive Approach – Step 3

- Construction/Rework of runway
  - Use best management practices
    - Use best available material
    - Provide surface drainage
    - Maximize compaction

MIDWEST

Comprehensive Approach – Step 4

- Pre-application data collection – baseline data
  - Data collection consisted of Humboldt Geogauge stiffness readings, determination of the Coefficient of Variability of the runway surface, visual observations and/or Boeing penetrometer readings
    - Stiffness readings and/or penetrometer readings used as a proxy for preserved value
    - Coefficient of variability used as a proxy for runway uniformity
    - Visual observations provide visual comparisons over time and dust level acceptance

MIDWEST

Comprehensive Approach – Step 5

- Product application
  - For topical applications, apply product after construction/rework – typical method
  - For blended applications, apply product during construction/rework – can be utilized with poor soils to achieve desired outputs

Comprehensive Approach – Step 5

- Topical Applications Verification:
  - Lab tested soils being utilized
  - Product is applied in several light passes to ensure penetration of product prior to subsequent passes
  - Spray nozzles fan the product – adjustment of spray nozzles or pump system may be necessary
  - Product design application rate is achieve
  - Compaction of surface at completion of application

MIDWEST

Comprehensive Approach – Step 5

- Blended applications are normally incorporated into poor soils during new construction and full depth or 6-inch surface layer rework.
- Blended Applications Construction Verifications:
  - Lab tested soils being utilized
  - Product is applied at the design application rate
  - Blended depth is achieved
  - Moisture content within acceptable range for maximum compaction
  - Design compaction is achieved

Comprehensive Approach – Step 6

- Post-application data collection 1-7 days after application
  - Data collection consisted of Humboldt Geogauge stiffness readings, determination of the Coefficient of Variability of the runway surface, visual observations and/or Boeing penetrometer readings
    - Stiffness readings and/or Boeing penetrometer used to verify the runway surface demonstrates the minimum required CBR value as specified by the requesting agency
    - Coefficient of variability used demonstrate the construction uniformity of the runway surface
    - Visual observations provide visual comparisons of dust levels as compared to pre-application levels

MIDWEST

Comprehensive Approach – Step 7

- Post-application data collection - yearly after application
  - Data compared to previous data collection events
    - Used to determine when maintenance applications are required
      - Determine when performance falls or is expected to fall below acceptable ranges
        - » Decline in CBR values
        - » Loss of fines resulting in
          - » Raveling
          - » washboarding
          - » Rutting
          - » Potholes
      - Increased dust levels

MIDWEST

Comprehensive Approach – Step 8

- Maintenance application of product to runway surface based on data, not feel
  - Typically ¼ to ½ of initial application rate
  - Dress up surface prior to application
  - Needs to be applied in similar manner as initial application
  - Pre and post-application data collection to determine new baseline

Comprehensive Approach – Life Cycle Cost Savings

- Life cycle cost savings realized through:
  - Less frequent maintenance applications of product
  - Lower application rates during maintenance applications
  - Less extensive preparation work for maintenance applications
- Additional benefits
  - Less aircraft damage
  - Safer runway conditions
  - Increase in grip
  - Decrease in dust levels
  - Environmentally friendly

MIDWEST

COMPREHENSIVE APPROACH WITH FINES PRESERVATION LIFE CYCLE HYPOTHESIS:

Illustration of Typical Runway 20 Year Maintenance Cost

2,66 to 4,000 ft. in length, ~ 100 ft wide
Average for sandy, silty and clayey gravel

Current Cost	
Gravel overlay in year 5	$57,000
Crushing project and major overlay in Year 10	$636,000
Gravel overlay in year 15	$57,000
Crushing project and major overlay in Year 20	$636,000
Total Cost	**$1,386,000**

Cost of Fines Preservation Program Using EK-35	
EK-35 treatment in year 1	$82,700
EK-35 treatment in year 2	$51,350
EK-35 treatment in year 3	$26,720
EK-35 treatment in year 7	$51,350
Gravel overlay in year 10	$57,000
EK-35 treatment in year 11	$82,700
EK-35 treatment in year 12	$51,350
EK-35 treatment in year 13	$26,720
EK-35 treatment in year 17	$51,350
Gravel overlay in year 20	$57,000
Total Cost	**$538,240**

Cost Savings Over 20 Years	
	$847,760
	61%

Source: Experience & Projections From Midwest Customers

- Typical airports used by more than 100 flights per week
- Aircraft sizes range from Cessna 172 to DC-4
- Annual cumulative Air Carrier cost savings estimated to be in excess of $70,000 per year

MIDWEST

Closing Remarks

- Utilizing a comprehensive approach to runway maintenance allows for maintenance decisions based on data, as opposed to being based on feel. The comprehensive approach will result in runways that will substantially retain their "as-constructed" performance with less dust and improved safety, while requiring fewer dollars to maintain the runway surface. Therefore, a life cycle cost savings is realized and more runways can be maintained for the same dollars.

For Information Contact:

Marc Poirier
Director of Sales – Canada
Midwest Industrial Supply, Inc.
marc.poirier@midwestind.com

David Justus
Sales Unit Manger – Alaska
Midwest Industrial Supply, Inc.
david.justus@midwestind.com

Chett Siefring
Geotechnical and Design Engineering Unit Manager
Midwest Industrial Supply, Inc.
chett.siefring@midwestind.com