ICRI National Convention March 18, 2016

Repair and Protection of Concrete Subject to Harsh Abuse in Mines and Elsewhere

• Physical Abuse
• Thermal Shock
• Chemical Attack
• Dynamic Loading

Dave Flax Manager Southwest Region
Business Development Group
The Euclid Chemical Company 858-405-0356
dflax@euclidchemical.com
I recently did a Webinar about the physical abuse of slabs.

An engineer texted me.

“*I am forming a non-profit organization whose mission is to put an end to slab abuse.*”
Dave Flax

♦ Civil Engineering Degree from RPI
♦ Over 35 years experience with concrete
♦ Years as a Field Engineer
♦ Years with a contractor
♦ Years with the Corps of Engineers doing research
♦ Published dozens of articles
♦ Specialized in cement and concrete
♦ Earned CDT and CCPR from CSI
♦ On many ICRI Committees
ABRASION RESISTANCE
Relative Abrasion Resistance
ASTM C 779

- Plain Concrete
- Liquid Densifier
- Mineral Aggregate Shake
- Nonoxidizing Metallic Aggregate Shake
- Metallic Shake or Iron Aggregate Topping

Percent of Reference Concrete
IMPACT RESISTANCE
LA Rattler: 2” cubes of material, 2” steel balls, rotate slowly for 2,000 cycles

2” cube
4,000 psi concrete
10,000 psi concrete with emery
12,000 psi cementitious topping with iron and natural aggregate
LA Rattler: 2” cubes of material, 2” steel balls, rotate slowly for 2,000 cycles

Used for one of the Toughest Abuses Known to Man
One of the Reasons for Development was Tipping Floors
The concrete between the rails kept chipping out because every rail created two more joints in the slab and joints are problems.

Using iron aggregate topping to infill the damage between rails finally solved their problems.
Wear between steel rails and around steel plates turned their yard into a washboard.
It was such a maintenance problem for them, they covered it all with iron aggregate topping.
Nucor Steel
Proper Surface Preparation
Keyed Edges
Bonding
SPEC NEEDS TO SAY:  
“Backroll with short nap roller.”

This makes the coverage uniform.
Magma Copper
Miami, AZ

Fast Setting Version
• Final Set: 15 minutes
• 1 Hour: 4,000 psi
TYPICAL NON-MINING USES:

- Transfer stations
- Tracked vehicle maintenance shop floors
- Steel foundries
- Heavy manufacturing
- Dam spillways (corrosion is not an issue)
- Loading docks
- Scales
- Rolloff dumpsters
- Anything and everything that takes a beating
Required:

- Pre-job meeting with minutes
- Thickness - minimum 1”
- Proper surface preparation
- Bonding agent
- Evaporation retarder
- Proper curing
- Contractor experience
COATINGS, LININGS, and TOPPINGS for CHEMICAL RESISTANCE
** Flake Filled Epoxy Novolac Coating, Broadcast, or Trowel-Down for Severe Chemical Attack like Tankhouses **

<table>
<thead>
<tr>
<th>Acids</th>
<th>Miscellaneouss</th>
<th>Alkalies / Salts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetic 50%</td>
<td>Brake Fluid</td>
<td>Ammonia 29% 1</td>
</tr>
<tr>
<td>10%</td>
<td>Ethylene Glycol</td>
<td>Ammonium Sulfate 50% 1</td>
</tr>
<tr>
<td>Chromic 10% 1 50% 1</td>
<td>Formaldehyde 37% 2</td>
<td>Calcium Chloride 1</td>
</tr>
<tr>
<td>Citric 10% 1 50% 1</td>
<td>Gasoline 1</td>
<td>Diethanolamine 1</td>
</tr>
<tr>
<td>Formic 25% 4 98% 4</td>
<td>Propylene Glycol 1</td>
<td>Ferric Chloride 50% 2D</td>
</tr>
<tr>
<td>Hydrochloric 10% 1 37% 1</td>
<td>Skydrol 1</td>
<td>Hydrogen Peroxide 35% 1D</td>
</tr>
<tr>
<td>Hydrofluoric 25% 4</td>
<td>Vegetable Oil 1</td>
<td>Potassium Hydroxide 50% 1</td>
</tr>
<tr>
<td>Lactic 85% 2</td>
<td>Ethyl Alcohol 95% 2</td>
<td>Sodium Hydroxide 50% 1</td>
</tr>
<tr>
<td>Nitric 10% 2 45% 4</td>
<td>Ethyl Acetate 4</td>
<td>Sodium Hypochlorite 10% 1D</td>
</tr>
<tr>
<td>Phosphoric 10% 1 85% 2</td>
<td>Methanol 4</td>
<td></td>
</tr>
<tr>
<td>Sulfuric 10% 1 75% 1</td>
<td>Methyl Ethyl Ketone 4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Methylene Chloride NR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mineral Spirits 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Toluene 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trichloroethane 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Xylene 2</td>
<td></td>
</tr>
</tbody>
</table>

** Solvents **

- Ethyl Alcohol 95% 2
- Ethyl Acetate 4
- Methanol 4
- Methyl Ethyl Ketone 4
- Methylene Chloride NR
- Mineral Spirits 1
- Toluene 2
- Trichloroethane 1
- Xylene 2

** Rating Key **

1 = Long Term Exposure (30 days)
2 = Extended Exposure (7 days)
3 = Splash / Spill (72 hours)
4 = Incidental Contact (8 hours)
D = Discoloration may occur
NR = Not Recommended
EPOXY TROWEL DOWN
Advantages:

• Abrasion Resistance
• Impact Resistance
• Chemical Resistant
• Easy to Clean
• Aesthetic
Hycroft Gold Mine
Winnemucca, NV

¼” Trowel Down
CEMENTITIOUS GROUT
EPOXY GROUT
DIFFERENCES BETWEEN CEMENTITIOUS AND EPOXY GROUTS

Consistency:
• Cementitious Flows while Epoxy Oozes

Sticks to Base Plate:
• Cementitious Doesn’t while Epoxy Does

Compressive Strength:
• Epoxy has Higher Early and Ultimate

Creep:
• Epoxy Creeps More at High Temperatures

Dynamic Loading:
• Cementitious with Natural Aggregate is Good
• Cementitious with Iron Aggregate is Better
• Epoxy is Best
When it comes to construction its:

• The contractor’s job to build it

• The Engineers’ job to tell them how in the spec

• My job to help with product selection and the spec

• All this so that the Owner gets the results they need
IF IT CANNOT BE GROWN, IT MUST BE MINED
Maintenance and Protection in Harsh Mine Environments

- Physical Abuse
- Thermal Shock
- Chemical Attack
- Dynamic Loading

Dave Flax
Manager Southwest Region
Business Development Group

The Euclid Chemical Company
858-405-0356
dflax@euclidchemical.com