Advanced Sealcoating

TAKE YOUR SEALCOATING TO THE NEXT LEVEL

- Sealer Composition
- Mix Designs & Proper Application
- Using Best Application Practices.
- Coverage Rates, Film Thickness
- Optimum Cure & Film Formation
- Additives types and Do's & Don't's

Presented by

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President, STAR, Inc.

1/15/18

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SPECIALTY TECHNOLOGY AND RESEARCH

Designed For
Sealcoating Professionals

Who want to learn
beyond the basics of Sealcoatings
to make every job look and
Perform the very best.

PERFORMANCE
THE CENTERPIECE

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PERFORMANCE
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CRITICAL FACTORS

1. GOOD QUALITY SEALER

Meets specifications, and has an established track record.

2. RIGHT MIX DESIGN

Follow recommendations (manufacturer or job specs.).

3. APPLY AT RECOMMENDED RATES

To deposit the right amount of sealer on the pavement.

4 DRY AND CURE UNDER RIGHT AMBIENT CONDITIONS

Temperature, humidity, wind velocity.

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SEALCOATINGS are stable water-based dispersions made up of the following key components:

1. **Binder (RT-12, Asphalt or Specialty Resin)** -Backbone of the sealer-
   - Provides protection against the elements: weather, salt, water, chemicals, etc.
   - Adhesion to the pavement.

2. **Clay and Fillers**
   - Body and flow during application
   - Tensile strength and toughness
   - Non-tracking properties

3. **Water: Medium of dispersion**
   - Ease of application
   - Safety in storage and handling

4. **Emulsifiers, Specialty Chemicals, & Additives (Optional).**
   - Help in dispersion
   - Provide stability and special properties

SEALCOATING BASICS

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What Makes A Good Sealer? How Can You Tell?

1. Meets /or Exceeds Specifications
   ASTM, FEDERAL, FAA, Local, etc.

2. Proven Performance
   Good Track Record.

3. Dark, Chocolate Brown in Color
   Indicating Fine Dispersion of Tar, AC or specialty resin.

4. pH - 7-8
   Below 7 slightly acidic: May be unstable
   Over 8 alkaline: prone to water sensitivity

5. References, Comparative Evaluation

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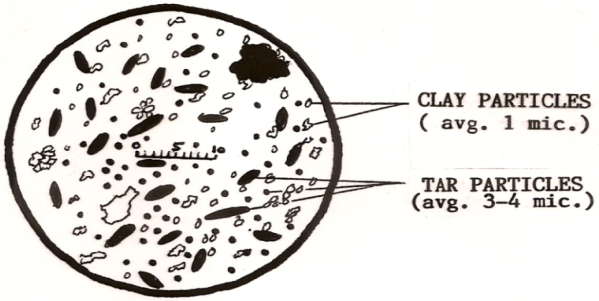
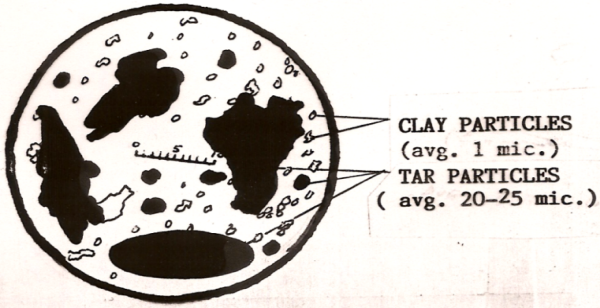
What Makes A Good Sealer? How Can You Tell?

MICROSCOPIC VIEW



EXCELLENT

RATIO (Tar/ Clay Particles) = 3.5/1



POOR

Ratio (Tar/Clay Particles) = 20-25/1

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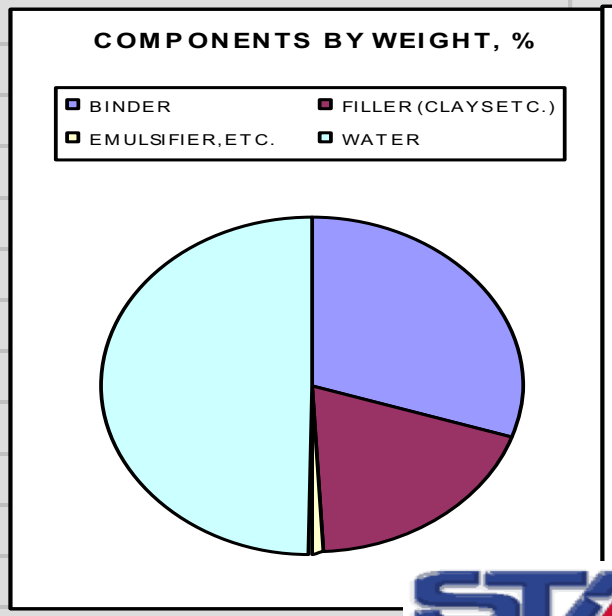
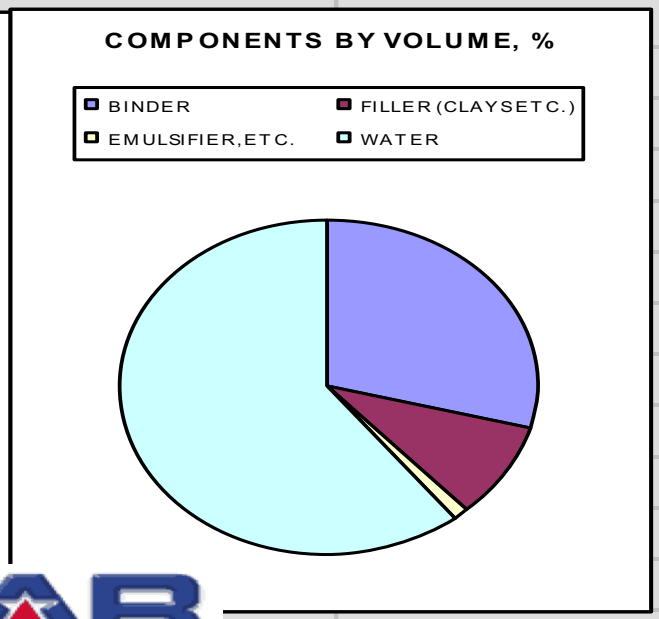
TYPICAL SEALER COMPOSITION
Undiluted (as manufactured)

SEALER COMPOSITION, %		
	BY WEIGHT	BY VOLUME
BINDER	30	29.3
FILLER (CLAYS ETC.)	19	8.9
EMULSIFIER,ETC.	1	1.3
WATER	50	60.5
TOTAL	**100**	**100.0**





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MIX DESIGNS

An Overview

Sealcoating is *never* applied in its concentrated form

Generally it is mixed with:

1. **WATER** — For Fluidity and Workability
2. **SILICA SAND**
   - Increases Traction
   - Produces Uniform Texture
   - Fills Voids in Pavement Profile & Bridges Minor Surface Cracks
3. **ADDITIVES (OPTIONAL)**
   - Performance Boosting:
   - Flexibility
   - Toughness
   - Resistance to salt, water, and chemicals
   - Faster Drying
   - Darker cured color

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MIX DESIGNS

STANDARD SYSTEM: A Two (2) coat system

SEALCOATING (CONC)	100 GAL
WATER (30% BY VOL.)	30 GAL
SILICA SAND /aggregate	200-300 lb

TOTAL - 145 GAL

MIX DESIGNS
An Overview

Application Rates

Gal (conc.) Sealer/Sq. Yard:

1st. Coat	0.10-0.12
2nd. Coat	0.08-0.10

TOTAL (2 COATS): 0.18-0.20 GAL/SQ YD

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MIX DESIGNS

RECOMMENDED SYSTEMS

Usage Area	Coats	STAR SEAL Gals.	WATER Gals.	SAND Lbs.	MACRO-FLEX Gals.	COVERAGE RATE Mix Gals./Sq. Yd.
LOW TRAFFIC	1st	100	30-40	200-300	0-3	0.15-0.20
Home Driveways, parking stalls walkways, cart and bicycle paths, etc.	2nd	100	25-40	0-300	0-3	0.10-0.15
MODERATE TRAFFIC	1st	100	30-50	300-500	0-4	0.15-0.20
Driveways, parking lots, airfield and highway shoulders, gas station aprons, etc.	2nd	100	30-50	0-500	0-4	0.10-0.15
HEAVY TRAFFIC	1st	100	30-60	400-600	0-5	0.15-0.20
Industrial & commercial parking lots, airfield taxiways, service stations, etc.	2nd	100	30-60	400-600	0-5	0.15-0.20
	3rd	100	30-40	0-500	0-4	0.10-0.15

The use of sand is recommended to increase the longevity of sealcoatings

Hazards in Altering The Mix Designs

Follow the recommended mix designs

Changing the mix design may cause performance problems

1. WATER:

A. EXCESSIVE:

- Thinner Dry Film Thickness (D.F.T.) - Poor Durability,
- Premature failure.

Important:

ADJUST APPLICATION RATE TO MAINTAIN DRY FILM THICKNESS.

B. NOT ENOUGH WATER-

- Poor Flow, uneven appearance - The sealer may not wet out the surface properly for good adhesion.
- Tracking is possible.

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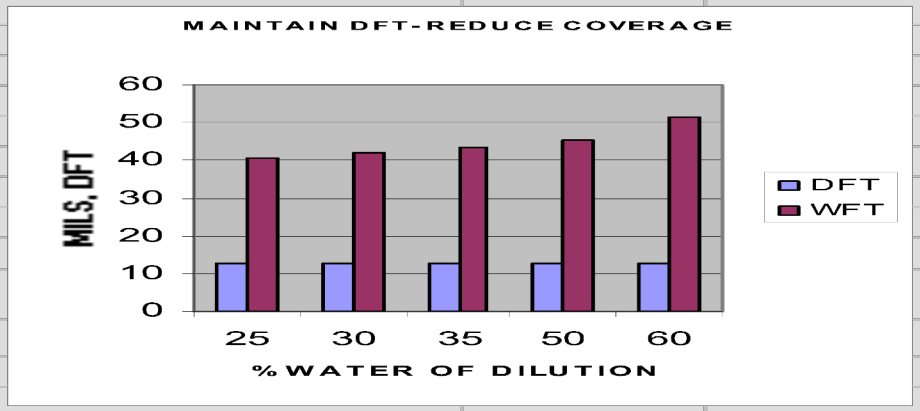
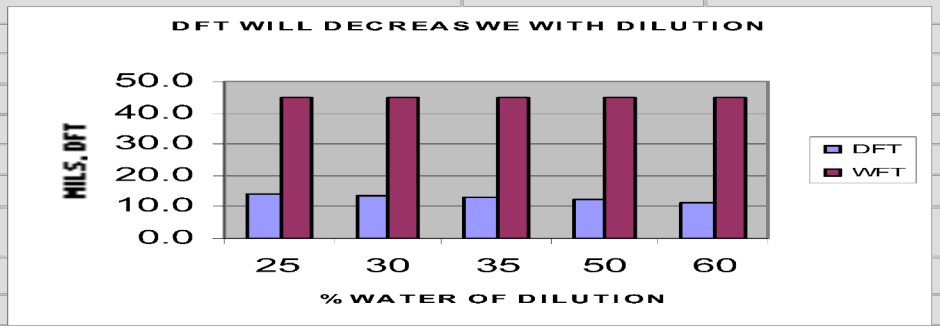
Hazards in Altering the Mix Designs

The coverage rate will have to be adjusted for higher amount of water to maintain the same Dry Film Thickness (DFT)

DILUTION RATE, %	DFT	WFT
25	12.8	40.4
30	12.8	42
35	12.8	43.6
50	12.8	45.2
60	12.8	51.6



DILUTION RATE, %	DFT	WFT
25	14.3	45
30	13.7	45
35	13.2	45
50	12.7	45
60	11.2	45



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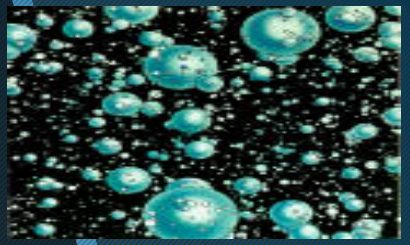
Hazards in Altering the Mix Designs

2. SAND/AGGREGATE



A. EXCESSIVE (OVER 5-6 Lb./Gal.)

- Poor flexibility, Brittleness
- Poor adhesion to pavement
- Poor anchoring
- Sand roll out
- Premature failure

B. NONE OR VERY LITTLE (<1 Lb./Gal.)

- Reduced traction/skid resistance
- Uneven texture and appearance
- Soft sheen (reflectance)
- Pavement voids not filled

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Hazards in Altering the Mix Designs

3. ADDITIVES

Very Selective

Follow Manufacturer's recommendations

May not be compatible with the sealer.

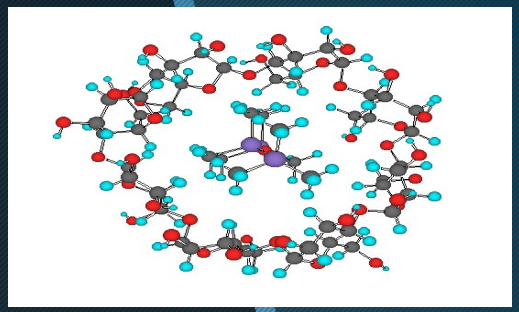
Do Not Mix & Match

EXCESSIVE (Over 5 %):

- Waste of Money
- May adversely affect properties

NOT ENOUGH (Less than1 %):

- Ineffective
- Marginal performance improvement
- Mostly for marketing ploy.



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Sealer Application Rates
Or Coverage Rates

AREA COVERED BY A GALLON OF CONC. SEALER
EXPRESSED IN 2 WAYS:

1. Gallons per square yard (gal./sq. yard)
Most commonly used.

OR

2. Square Feet/ Gallon

A typical Coverage Rate for a two (2) coat application is 0.18-0.20 gal (undiluted) sealer/sq. yard

1st Coat- 0.10-0.12 gal./sq. yd.
2nd Coat-0.08-0.10 gal./sq. yd.

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Sealer Application Rates
Or Coverage Rates

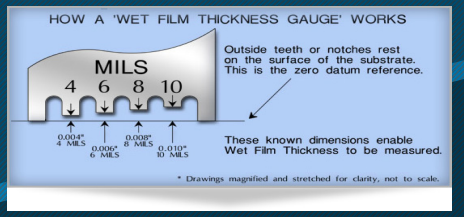
1. COVERAGE RATE

Sealer must be applied at the recommended coverage rate.

It is assured by measuring:

-Wet Film Thickness (WFT) &

- Calculating Dry Film Thickness (D.F.T.)



2. CURE CONDITIONS: Must be right.

Temperature-Ground & Surface)

Humidity or Relative Humidity-

Capacity of air to hold water at ambient temperature.

3. Wind Velocity- Also a factor.

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SEALCOATING PERFORMANCE CRIITICAL FACTORS

STEP 1

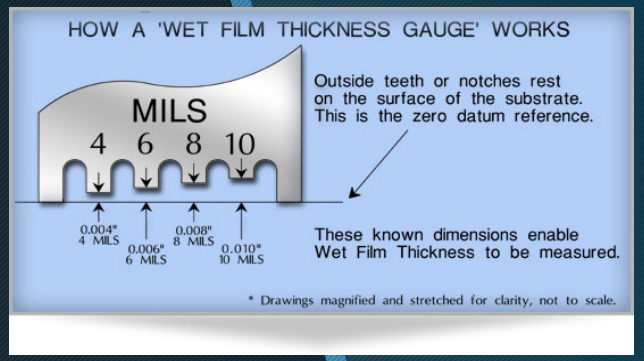
Determine the Wet Film Thickness (W.F.T.)

Two methods:

1. Calculate- Apply sealer on a known area (sq. feet) and divide gallons used to get coverage in sq. ft./gallon.

   Wet Film Thickness (W.F.T.) = 1604/coverage in sq. ft.

2. Use a wet film thickness gauge



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COVERAGE RATE

CONFIRMATION OF THE WET FILM THICKNESS

STEP 1- CALCULATION

Determine the Wet Film Thickness (WFT)

Expressed in mils. 1 Mil. 1/1000 inch.

If coverage is known in

A. SQ. Ft./Gal.- *Divide into 1604 (constant)*

Example- 50 sq. ft/gal.

Wet Film Thickness (WFT) = 1604/50 = 32 Mils.

What is 1604?

It is a constant denoting that one gallon of coating covers 1604 sq. ft. in one (1) mil film thickness.

B. Gallon/ Sq. Yard- Multiply with 178.2 (Constant)

Math is a bit complicated.

Example 0.18 Gal./Sq. Yard

W.F.T. = 178.2 X 0.18 = 32 mils.

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CALCULATION OF DRY FILM THICKNESS (D.F.T.)

STEP 2

Determine the solids % by Volume

MIX DESIGN		
INGREDIENTS	**GALLONS**	**SOLID (% VOL.)**
SEALER (CONC.)	100	40
WATER *	40	0
SAND/ AGGREGATE	13.9 (300 LB)	13.9
ADDITIVE	2	0.8
TOTAL	155.9	101.2

* More water while using an additive

COVERAGE RATE

Calculate % solids by volume

Solids (% by Vol.) = 101.2/155.9 = 35%

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CALCULATION OF DRY FILM THICKNESS (D.F.T.)

STEP 3

Calculate Dry Film Thickness (D.F.T.)

Multiply Wet Film Thickness (W.F.T) with % Solids by volume

D.F.T = W.F.T. x % solids by vol.

Example:

D.F.T. = 32 mils x 0.35 = 11.2 mils.

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DRYING & CURING
OF SEALCOATINGS

DRYING- EARLY STAGES
CURING-FINAL FILM SET UP

Sealcoatings cure through:

1. Release of Water -Evaporation
2. Film Shrinks in volume
3. Particles of the binder and filler are forced to coalesce
4. Binder particles soften, fuse and envelope clay/filler particles.
5. Continuous sealer film is formed.

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DRYING & CURING OF SEALCOATINGS

We Will Discuss

1. THE CURE MECHANISM

2. FACTORS AFFECTING CURE

TEMPERATURE: Surface & Ambient

RELATIVE HUMIDITY (% R.H.)

WIND VELOCITY

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DRYING & CURING OF SEALCOATINGS

1. Cure Mechanism:

- ★ Sealcoatings are water-based
- ★ Water represents the largest portion of mix design (65%)
- ★ They dry/cure by releasing water.
- ★ As water evaporates, the film shrinks in volume (to 35%, which remains as dry film.
- ★ Binder (tar/asphalt/new resin) and clay/filler particles are forced into a close proximity.
- ★ Binder particles touch each other and start fusing, thus enveloping clay/filler particles and bonding to the pavement.
- ★ *Continuous film results: Free of voids*

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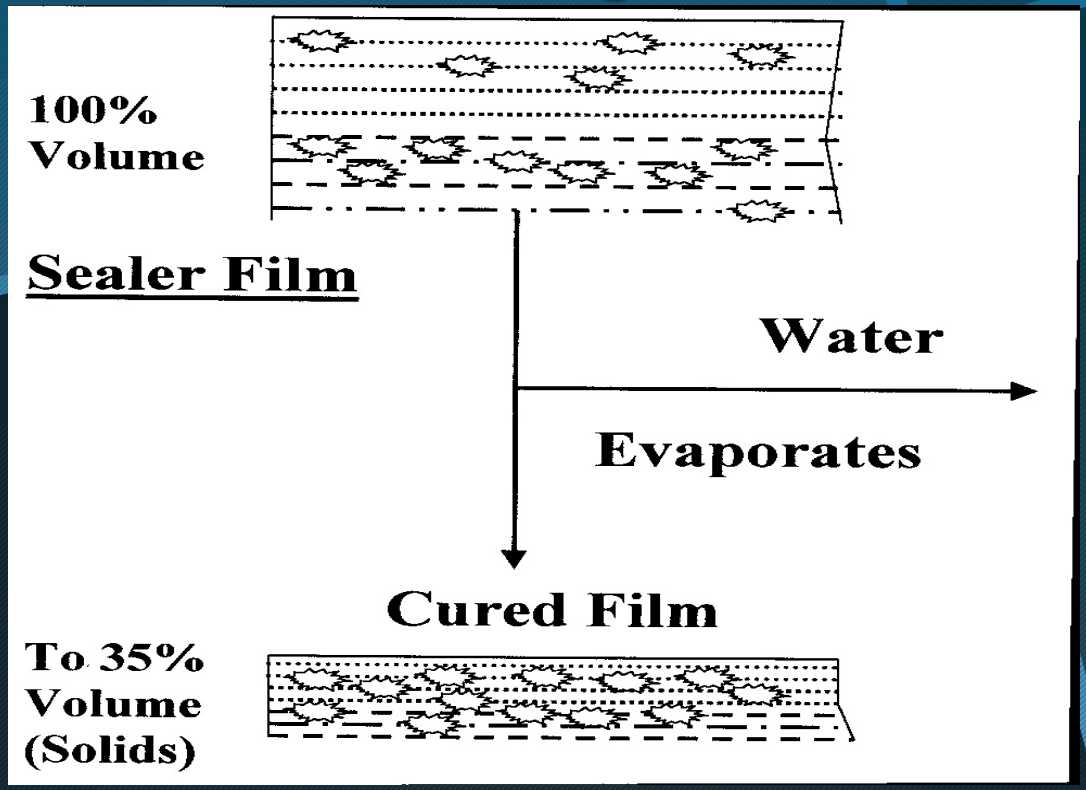
DRYING & CURING OF SEALCOATINGS

CURE MECHANISM:

Volume Shrinkage in Film



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DRYING & CURING OF SEALCOATINGS

CURE MECHANISM

Sealer wet film:

a. Is multi-layered (composite) layer of many thin films.

b. Each layer dries individually from top to bottom.

c. The release of water becomes more difficult as each layer dries.

d. Bottom layer takes longer to cure.

e. The sealer may appear fully dry on the surface but the bottom layers may still be soft.

Allow sufficient drying time.

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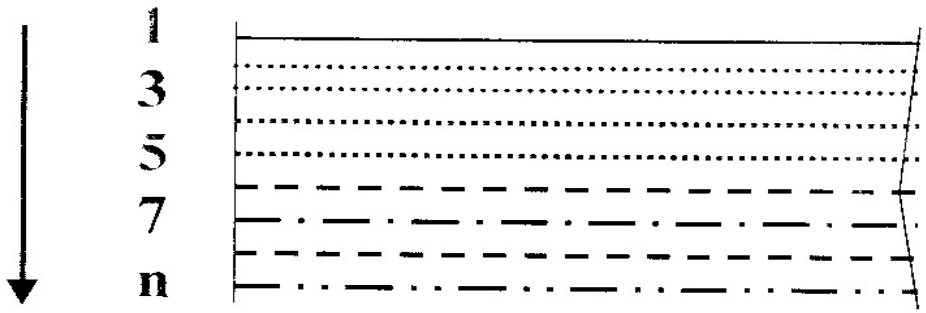
DRYING & CURING OF SEALCOATINGS

Sealer Film - Multiple Layer (Composite)



Film dries from the top to bottom

Film may appear dry on the surface, but may not be fully dry.

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2. CURE CONDITIONS

Factors Affecting Drying

TEMPERATURE
(ambient & surface)

Min. 50^0 F and rising.

A. Lower temperatures:

- **Poor film formation**
- **Binder particles do not soften properly to fuse and form a continuous film**

It may result in:

- Poor performance
- Sealer properties are lost, seldom recovered
- Gray color in initial drying

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2. CURE CONDITIONS

Factors Affecting Drying-Contd,

B. Higher Temperatures: Over 90 Deg. F

Water flashes off, immobilizing the binder particles in the film, thus keeping the sealer from forming a continuous film.

It may result in:

- Tracking
- Pin holing
- Sand balling
- Drying while brushing or squeegeeing.
- Poor and streaky appearance.

Humidity

It is the capacity of the surrounding air to hold water

Low Humidity: Very favorable for drying and curing. Will speed up drying.
High Humidity: Slow cure. Need more drying time.

WIND VELOCITY

5-10 mph wind helps sealer dry faster.

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2. CURE CONDITIONS –Factors affecting drying and cure..

Humidity

It is the capacity of the surrounding air to hold water.

Relative Humidity (R.H.):

Capacity (%) of air to hold water vapor at a particular temperature.

Low R.H. means the air has room to absorb more water vapor .

30% means that air still has 70% capacity to hold moisture.

Good for sealer drying.

High R.H. means that air has very little room to absorb more water vapor. Imagine a soaked paper towel. It can absorb only so much.

80% means that air has only 20% capacity left to hold more moisture.

Poor for sealer drying.

Air is like a blotting paper or a sponge

It will keep absorbing water as long as it is not saturated.

The capacity of the Air to hold water vapor will change with temperature.

Higher temperature=Higher the capacity

Air will expand.

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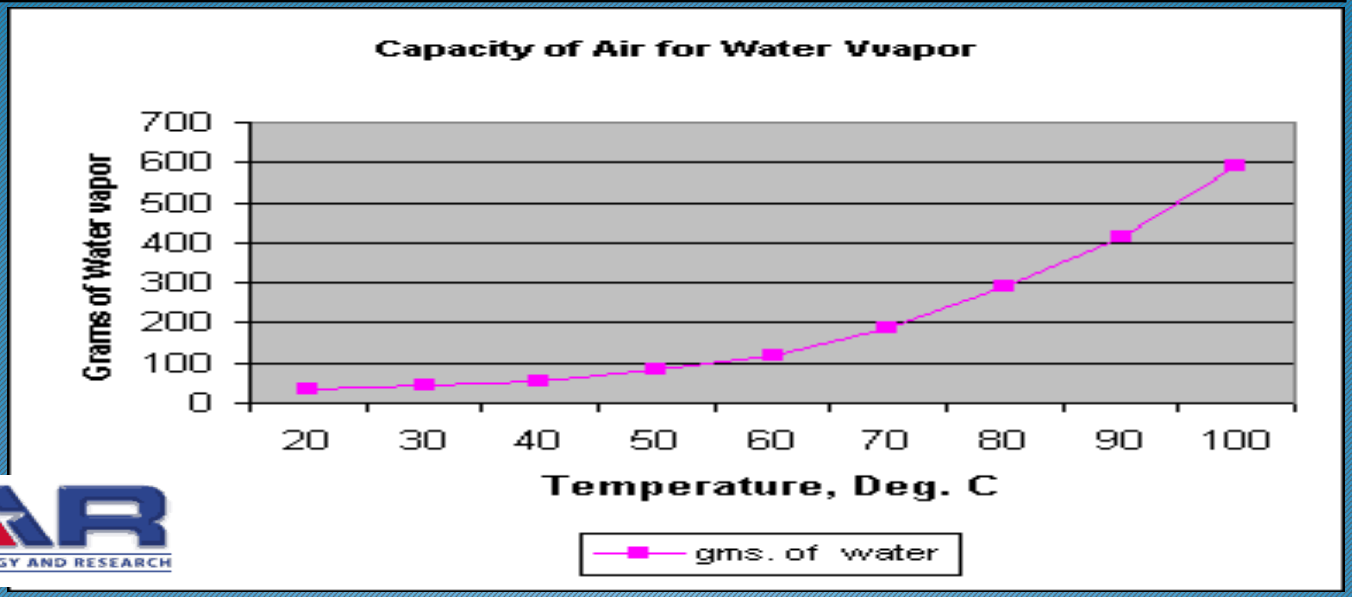
CAPACITY OF AIR TO HOLD WATER VAPOR
@ SATURATION VS. TEMPERATURE

Temperature ° C	Grams of water
20	35
30	45
40	55
50	85
60	120
70	185
80	290
90	415
100	590



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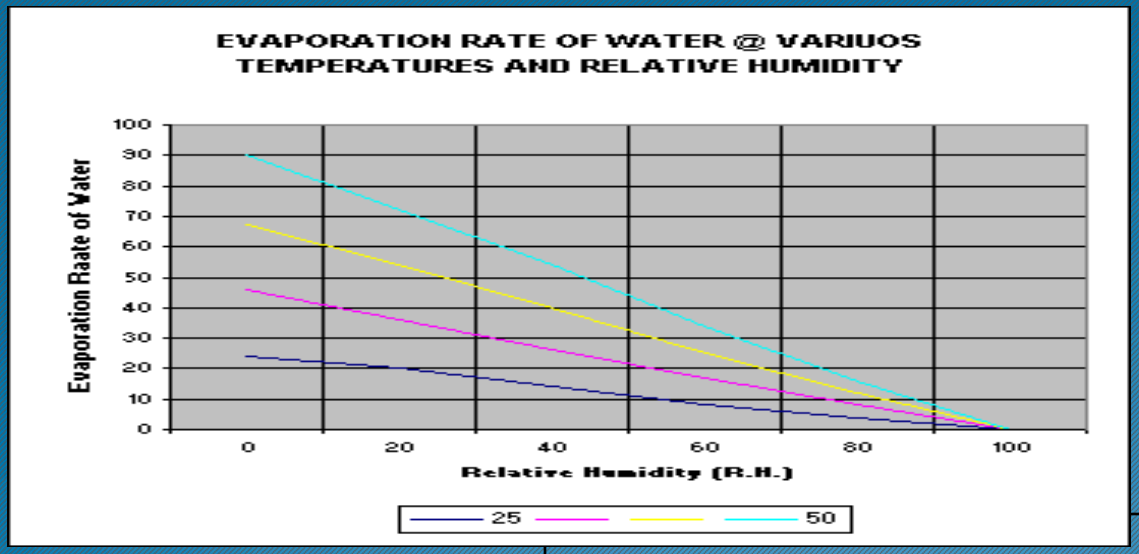
EVAPORATION RATE
@ VARIOUS R.H. and TEMPERATURE



Relative Humidity	Temperature, Deg. Celsius			
	25	35	45	50
0	24	46	67	90
20	20	36	54	72
40	14	26	40	54
60	8	17	25	34
80	4	8	12	16
100	0	0	0	0

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DRYING & CURING
OF SEALCOATINGS.

Favorable Conditions

- ★ Moderate Temperatures
- ★ Low humidity
- ★ Moderate wind velocity

Unfavorable Conditions

- ★ Low Temperatures
- ★ High humidity
- ★ Stagnant wind

General

★ Allow each coat to dry sufficiently, prior to applying the subsequent coating.

★ Take light vehicular traffic (application equipment - e.g. spray rig) scuffing and tearing.

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SEALCOATINGS

Important

Storm Water Best Management (BMGs)

PROTECTING THE ENVIRONMENT IS YOUR RESPONSIBILTY

Prevent Run-Offs and Take All Essential Steps
for Safeguarding the Environment.

CONTRACTORS - PLAN, MINIMIZE & MITIGATE

1. Plan:

- Educate and Enforce all the details about application, cure conditions and safety precautions given by our supplier. Read Safety Data Sheet.
- Identify important natural resources/ environmentally sensitive areas.
- Don't seal within 100 ft. of a wetland.

2. Do not apply if rain or thunderstorm is in the forecast within 24 hrs.

3. Do not apply if too early or too late in the season. Asphalt surface must be 50 deg. F.

4. Minimize Impact: Reduce potential run-off/pollutant loads (not only sealer) Block during application.

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ADDITIVES

1. WHAT ARE ADDITIVES?
   - ★ Definitions
   - ★ Types

2. WHAT THEY DO & HOW THEY IMPROVE THE SEALER PERFORMANCE?
   - ★ Add demonstrable cost-benefits value, e.g. longevity,…
   - ★ Qualifying for FAA and other applicable specs.
   - ★ Resistance to Chemicals, de-icing salts, oil, gas, etc.
   - ★ Improve Flexibly, tensile strength, adhesion, etc.

3. WHAT THEY DO NOT DO?

   Compensate For Poor Performance caused by Excessive Amount of Water and Sand

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ADDITIVES

DEFINITION

ADDTIVES

Materials Added to Sealcoatings to

ACCOMPLISH SPECIFIC

PERFORMANCE OBJECTIVES

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ADDITIVES

Objectives

1. IMPROVED PROPERTIES:

- Flexibility, elongation & tensile strength.
- Impact resistance
- Toughness
- Water resistance
- Resistance to chemicals, de-icing salts, oils, fats, grease etc.

2. FAST DRYING:

Even under not-so-ideal weather conditions., e.g.

Early spring, late fall, Night- time sealcoating..

3. UNIFORM DRY COLOR:

Under shade or shine.

4. THICKENING:

- To accommodate large amounts of water.
- Sand or Aggregate Suspension.
- No balling or streaking of the sealer.

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ADDITIVES

for Boosting Performance

Have been used for the last 40-50 years.

Extensively used since mid-70's

FAA specified (P-631)

A/B (Acrylonitrile/butadiene) rubber latex

For most sealcoatings.

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PERFORMANCE-BOOSTING *RUBBERIZING ADDITIVES*
For sealcoatings

A/B (Arylonitrile/butadiene) rubber latex for most sealers.

1. REDUCE TEMPERATURE SUSCEPTIBILITY

Reduce Softening and Tackiness (flow) in the hot summer months & brittleness in the winter months.

2. INCREASE TOUGHNESS

Greater resistance to abrasion and wear, for improved durability.

3. IMPROVED FLEXIBILITY & AND ADHESION

Better anchoring of aggregates.

4. THICKENING- Better sand suspension, controlled flow, especially on inclined surfaces.

5. FAST DRYING- Even under not-so-ideal conditions.

6. UNIFORM DRIED AND DARKER COLOR.

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RUBBERIZING ADDITIVES
HOW DO THEY WORK ?

Rubberizing additives are water emulsion of polymer molecules.

Polymers (selected) have

- **Large chain length, heavily branched.**
- **Excellent resistance to chemicals, salts, water, weathering, etc.**

When mixed with the sealer

Polymer chains, which become a part of the binder in sealcoatings, form a flexible and tough network which holds fillers, and aggregates tenaciously, while bonding to the pavement surface.

The polymer network, thus formed, expels water out of the film at a uniform rate, thus, helping the sealer dry faster.

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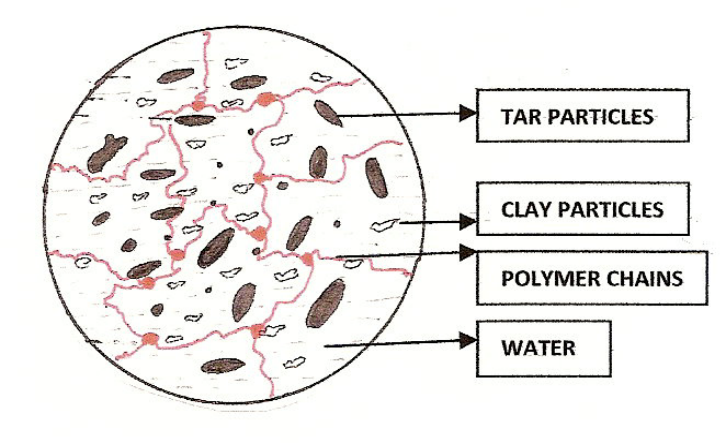
AS THE SEALCOATING DRIES

- Polymer network tightens within the film, it forces water out at a uniform rate, producing uniform dry color.



- Polymer fuses into the binder, thus, improving
  - FLEXIBILITY, TOUGHNESS
  - FUEL & CHEMICAL RESISTANCE.
  - SAND SUSPENSION AND ANCHORING
  - FAST DRYING.

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THE POLYMER USED FOR THE ADDITIVE

Must be resistant to:

- Weathering
- Gasoline, oils, fats
- Salts
- Petrochemicals
- Other chemicals

Any inherent weakness in the polymer will introduce weak links in the sealer and may cause premature failure.

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A Majority of Polymeric Additives

Produce Thickening,

Speed up Drying Time,

Produce Uniform Dry Color

Help to Suspend Aggregates.

But the polymers that are used in STAR additives really improve the following properties, in addition to the above.

Flexibility, Toughness, Temperature Susceptibility etc.

Improve resistance to Chemicals, oils, fats, grease,

de-icing salts, aromatic fuels etc.

In Essence Our Additives Improve The Overall Longevity Of Sealcoatings.

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ADDITIVES

The Right Additive Used in Right Proportion will;

- **Reinforce the properties,**
- **Improve the overall performance**

But Will Not Overcome:

Mix design deficiencies caused by the excessive amounts of:

-Water- thinner dry films

-Sand/Aggregate- May not supply enough binder to satisfy the demand of the excessive amounts of aggregates used in the mix.

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ADDITIVES: CONCLUSIONS

1. Acrylonitrile/Butadiene polymers (NBR TYPE) have the best overall properties.
   - They reinforce and boost the properties of asphalt and refined tar based & specialty resins sealers.
   - Better resistance to oils and other petrochemicals than Styrene/Butadiene polymers.
   - The rest of the properties are similar.

2. Polyvinyl Acetate/acrylic co-polymers (PVAs) are not recommended due to poor water and alkali resistance. Introduce weak spots in the film when attacked by water. Useful only as thickeners and for speeding up drying.

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Questions?

Thank You for your time for watching this presentation.

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