Terrazzo Quality Can Be Impacted by Limitations in the Concrete

Scott M. Tarr, PE FACI

NORTH S.TARR
CONCRETE CONSULTING, P.C.
Guidance to Concrete Solutions

THE NATIONAL TERRAZZO & MOSAIC ASSOCIATION

September 14, 2023

1

2

Scott M. Tarr, North S.Tarr Concrete Consulting
STarr@NorthSTarrConcrete.com

3

Todays Agenda

- Water in Concrete – where does it go?
- Curling (warping)
- Fibers
- Type 1L Cement
- Coefficient of Thermal Expansion
  - Delamination
- Moisture Movement and pH
  - Osmotic Blisters
  - Alkali Silica Reactivity (ASR)

4

Water is Essential to Concrete

1. Mixability, Workability, Consistency, Placeability, Consolidation, Pumpability, Finishability, and Bleed/Setting Behavior
2. Cement Hydration.
3. Curing.

5

Not Toot Much Water

- Segregation
- Lower Strength
- Lower Wear Resistance
- Surface Issues
  - Dusting
  - Delaminations
  - Popouts
- Shrinkage and Curling

6

Where Does the Water (Moisture) Go?

- Compare Cement and Epoxy Terrazzo
- Identical Conditions
- Quality Vapor Retarder
- Concrete the Same Age
- Curling Ground Out Before Terrazzo Installation
- Cementitious Continued to Curl and Epoxy Did Not
- Why?

7

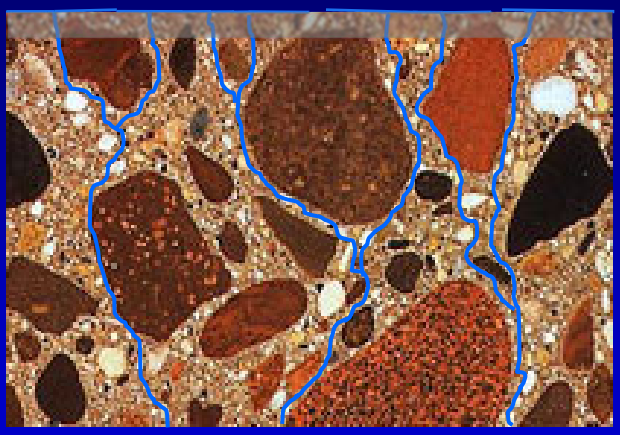
Every Truckload Delivers Over 100 Gallons of Free Water!

8

Placement and Bleed

9

Bleeding Concentrates Alkali Salts at Surface

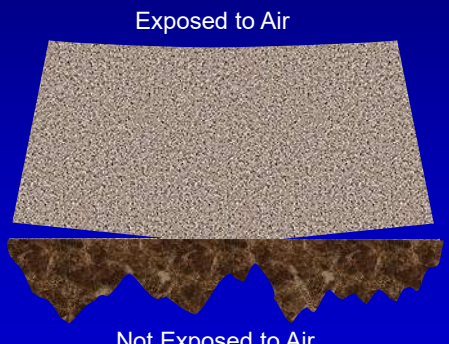


10

Bleeding Concentrates Alkali Salts at Surface

11

The Rest of the Water Slowly Evaporates Which Causes Issues



12

Curling/Warping

How Does One Know if a Joint or Crack is Curled/Warped?

6 foot level or long straightedge

13

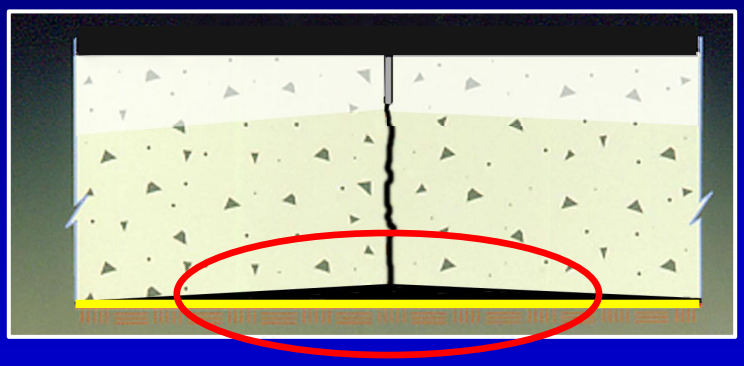
Curling/Warping

Shrinkage – Curling/Warping Relaxation

14

Curling/Warping

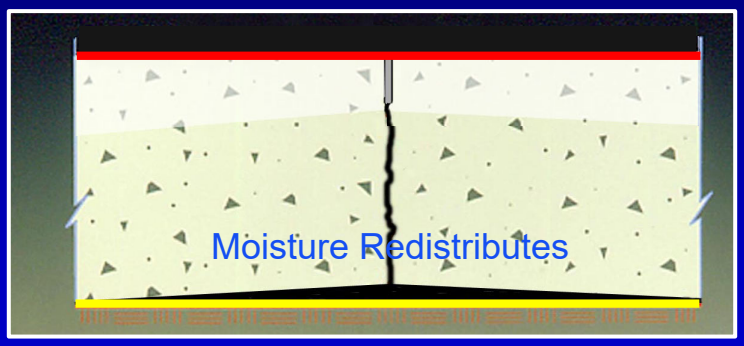
Shrinkage – Curling/Warping Relaxation



15

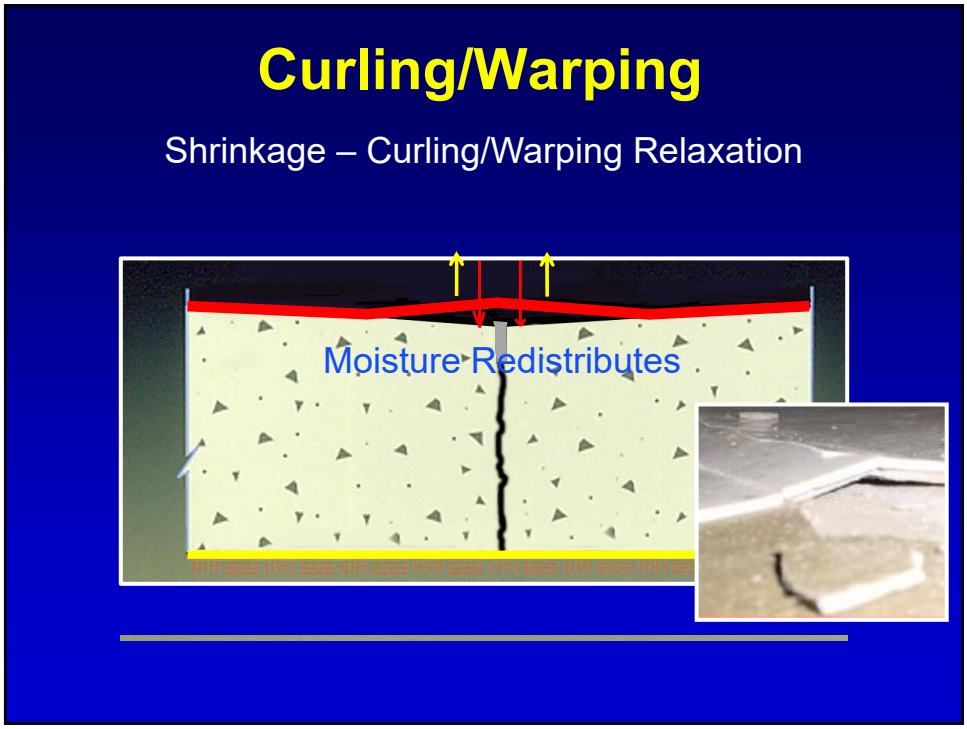
Curling/Warping

Shrinkage – Curling/Warping Relaxation

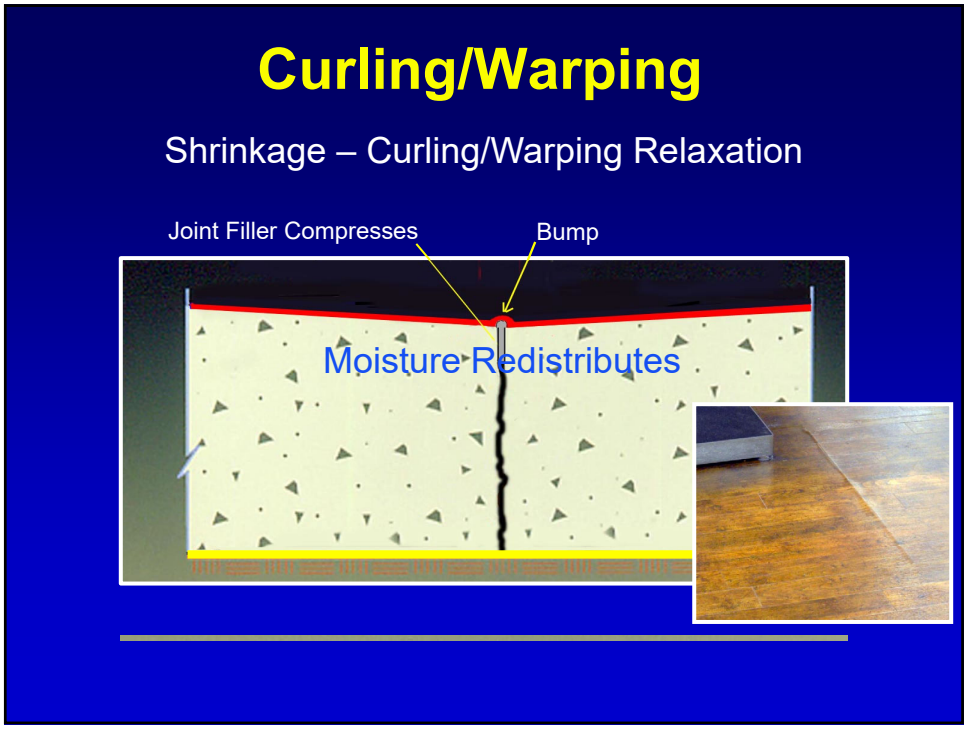


16

Scott M. Tarr, North S.Tarr Concrete Consulting
STarr@NorthSTarrConcrete.com


Curling/Warping
Shrinkage – Curling/Warping Relaxation
Moisture Redistributes

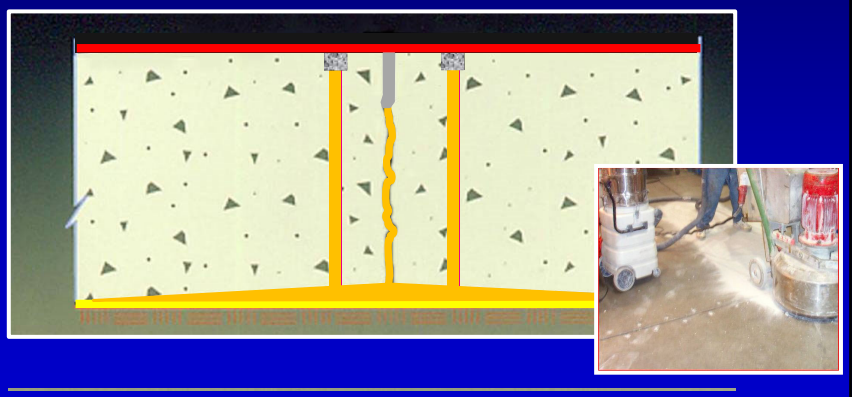
17


Curling/Warping
Shrinkage – Curling/Warping Relaxation
Joint Filler Compresses
Bump
Moisture Redistributes

18

Curling/Warping

Shrinkage – Curling/Warping Relaxation Solution



19

How to Stop Curling?

- Shrinkage-Compensated Concrete
- Post-Tensioned Concrete Slab Design
- All Other Concrete Will Dry and Shrink (and Curl)
- How Can We Minimize Shrinkage/Curling
- Optimize Concrete Mix Design
  - Maximize Aggregate Size and Content
  - Minimize Paste Content (Cement and Water)
- Decrease Joint/Crack Spacing?
  - Extended-Joint Slab Designs
  - Reinforcement – Fibers?

20

Fibers?

- Reinforce Concrete to Result in Many Closely-Spaced Cracks
  - Steel or Polypropylene?
  - Length and Shape of Fibers?
- Cracks Remain Tight if Fiber Design Correct
- Are Tight Cracks an Easier Substrate Than Joints?
- Can Fibers Inhibit Bond?

21

Type 1L Cement

- Reduction of the Carbon Footprint (Carbon Neutrality Initiative)
  - Reduced Cement Clinker
  - Limestone Fines (up to 15% instead of 5%)
- Potential Impact on Strength?
- Potential Impact on Setting?
- Potential Impact on Bleeding?
- Variation in Limestone Content? (Consistency Throughout Placement)

22

Slabs Shrink But Do They Expand Too????

- They Can!
  - Concrete Shrinkage and Contraction
    - Loss of Moisture and/or Temperature
  - Concrete Swelling and Expansion
    - Gain of Moisture and/or Temperature
- Curling/Warping Relaxation
- Climatized or Non-Climatized?

23

Temperature Expansion Pavement Blow-Ups

24

Joint Movement Due to Moisture and Temperature Fluctuations

25

26

27

28

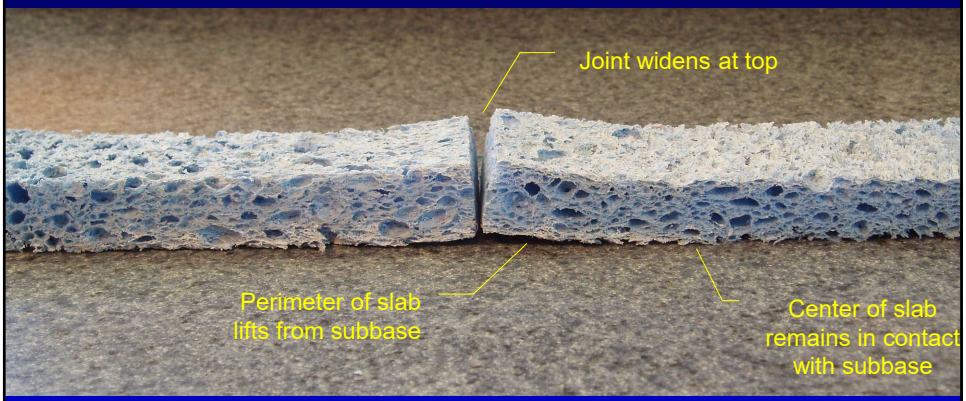
Scott M. Tarr, North S.Tarr Concrete Consulting
STarr@NorthSTarrConcrete.com

29

Concrete *is* a Sponge. When uniformly moist, a slab is flat.

30

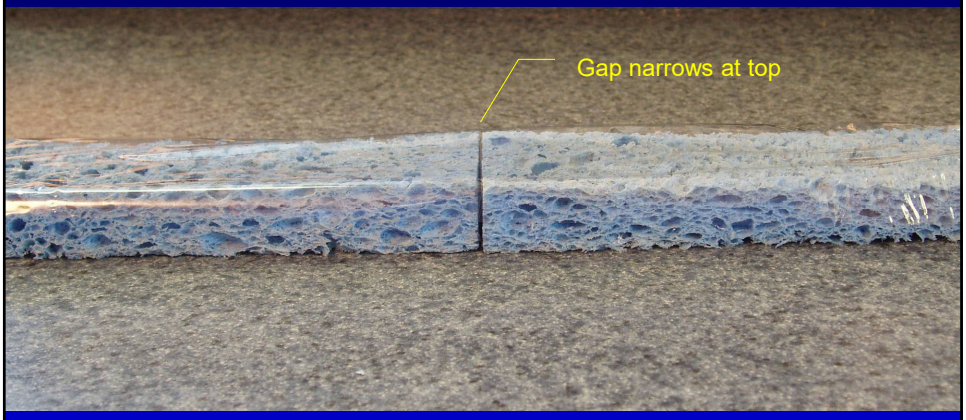
Sawcut joints start life flat, but drying causes upward warping:



CTL GROUP Building Knowledge. Delivering Results.

31

When an impermeable surface is installed, moisture redistributes and the curl relaxes:



CTL GROUP Building Knowledge. Delivering Results.

32

Floor Covering Failure Due to Warping Relaxation

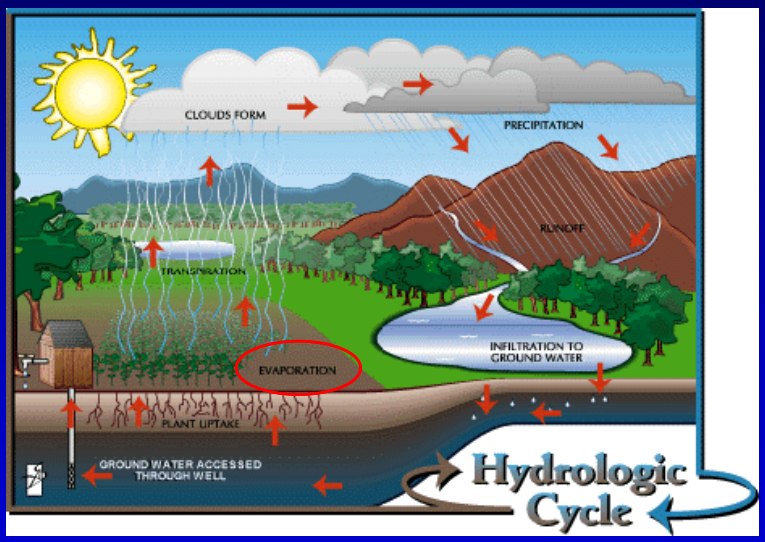
WORLD OF CONCRETE

33

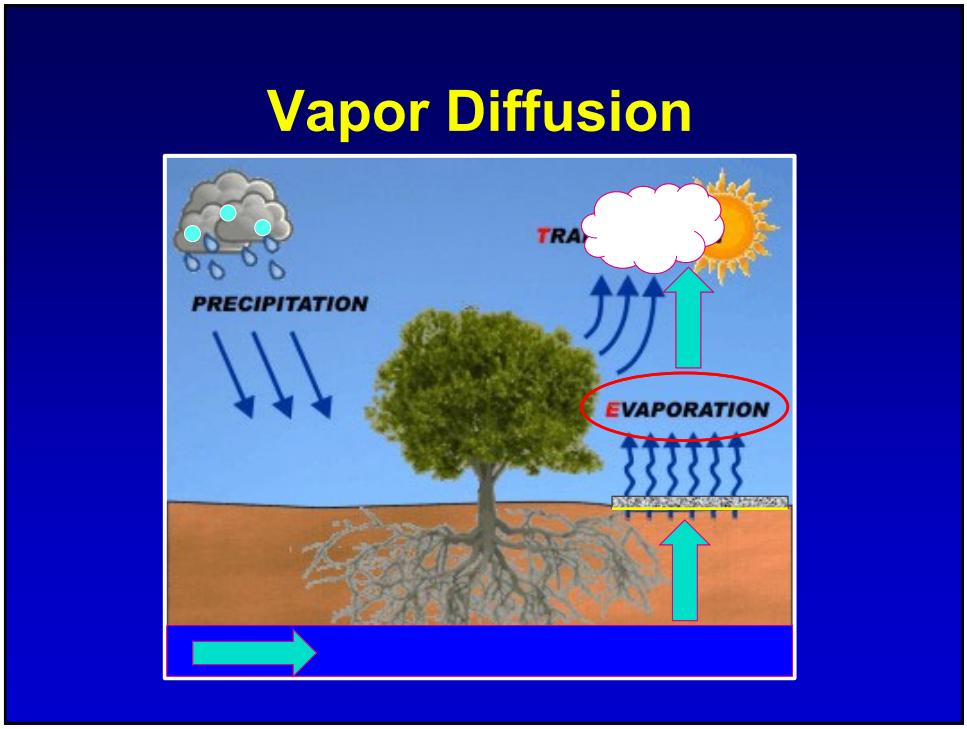
34

35

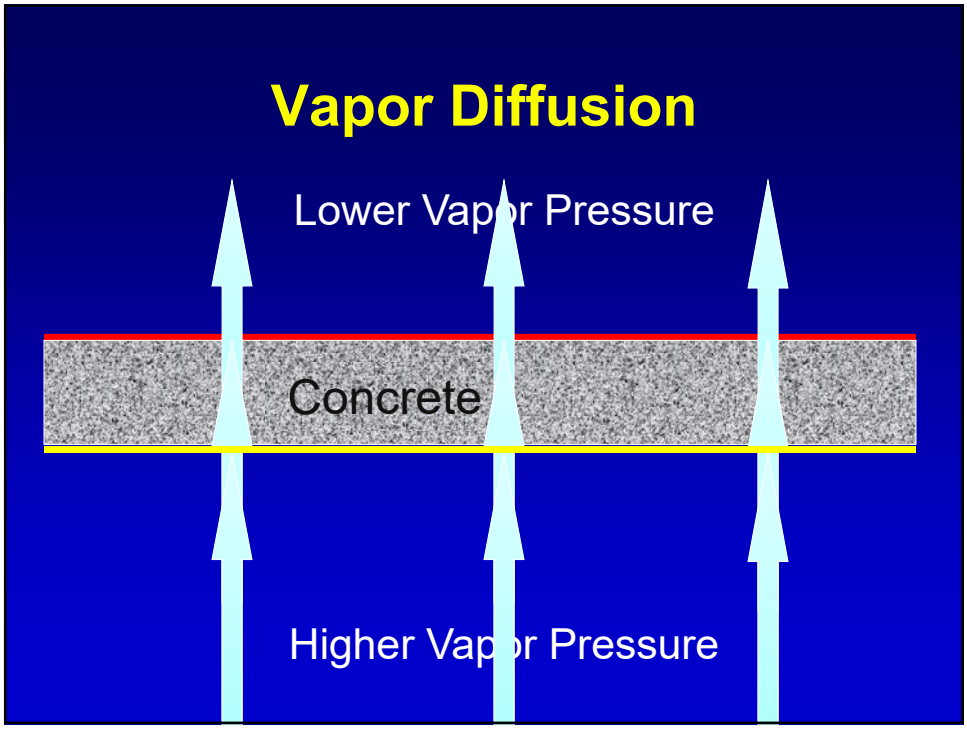
Vapor Diffusion



36



37



38

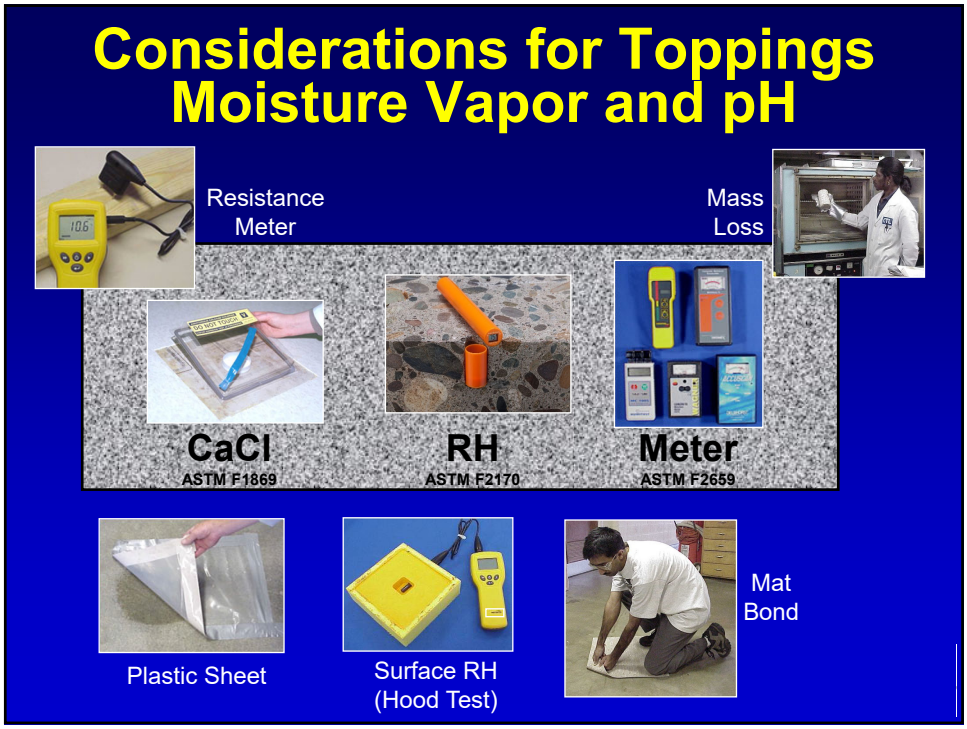
Scott M. Tarr, North S.Tarr Concrete Consulting
STarr@NorthSTarrConcrete.com

39

40


MOXON

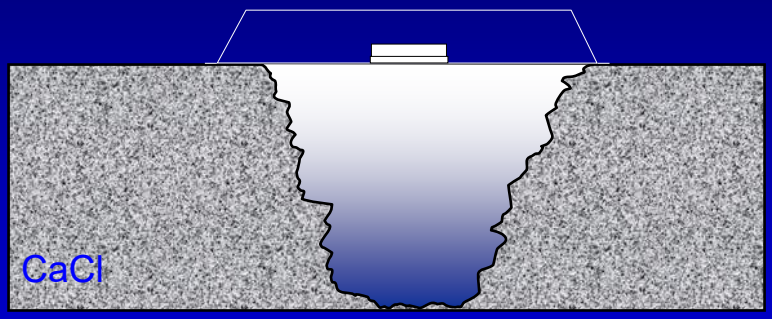
41


Considerations for Toppings
Moisture Vapor and pH
Resistance Meter
Mass Loss
CaCl
ASTM F1869
RH
ASTM F2170
Meter
ASTM F2659
Plastic Sheet
Surface RH (Hood Test)
Mat Bond

42

Considerations for Toppings Moisture Vapor and pH

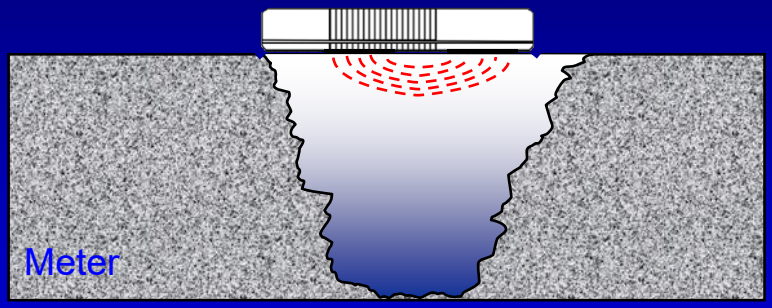
What Moisture is Measured?



43

Considerations for Toppings Moisture Vapor and pH

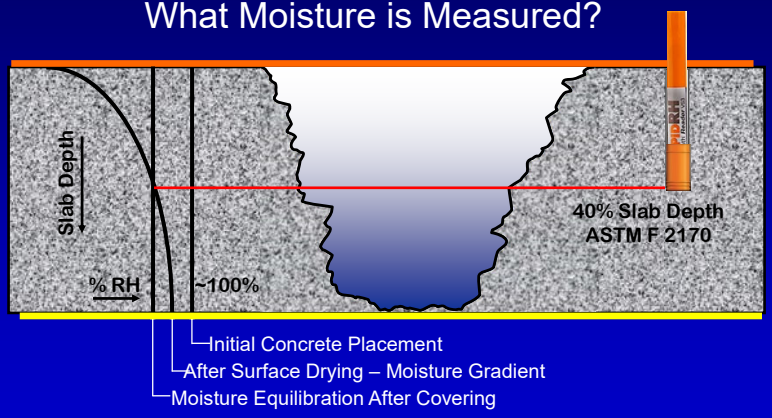
What Moisture is Measured?



44

Considerations for Toppings Moisture Vapor and pH

What Moisture is Measured?



If Moisture is High Enough to Condense to a Liquid Beneath the Floor Covering, pH Can Result in Damage

45

Considerations for Toppings Moisture Vapor and pH

pH

Is a measure of hydrogen ions in solution

46

47

48

Scott M. Tarr, North S.Tarr Concrete Consulting
STarr@NorthSTarrConcrete.com


DO NOT LAY DOWN ON THIS SIDE
NO APOYE SOBRE ESTE LADO
NE PAS PLACER À L'HORIZONTAL SUR CE COTÉ
Amana
Freeze Bottom Drawer
4.6 Cu. Ft. Capacity
AFC0507BW
Tiroir Du Bas
Capacité de 130 L

49

50

Considerations for Toppings Moisture Vapor and pH

When we Perform the pH Test…

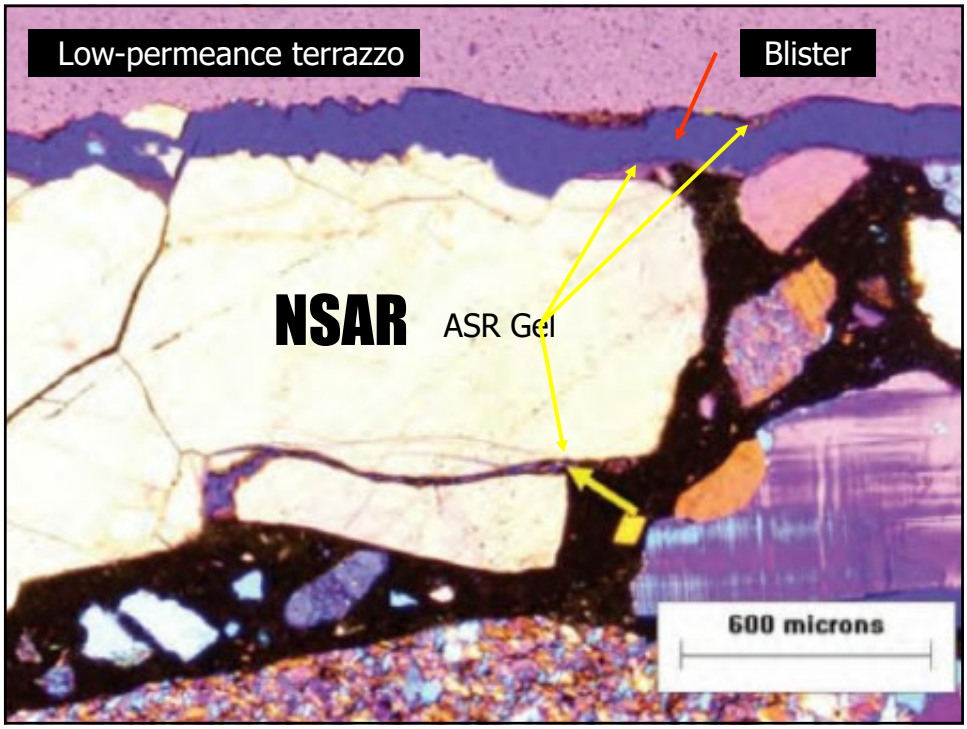
- We are Performing Chemistry
- We add Water to Create a Solution
- We Assume the Concrete Contains Enough Moisture to Create an Identical Solution Under the Finish Flooring
- If the Concrete is Sufficiently Dry, the pH Test is Not Representative
- A "Dry" Material has NO pH

Is the pH Test Valid?

51

Osmotic Blisters

52


Low-permeance terrazzo
Blister
NSAR
ASR Gel
600 microns

53


Questions?

54