History of Asphalt Rubber in Arizona

George Way
Consulpav

2012 Arizona Pavements/Materials Conference

October 31, 2012
Tempe, Arizona

- Asphalt Rubber
- The Early Years, Trial and Error
- SAM’s and SAMI’s
- Hot Plant Mixes, Gap Graded and Open Graded
- Benefits
- The People and Organizations
- The Future

Historical Overview of Crumb Rubber in Asphalt

1960s Charles McDonald Experiments w/AR

1970s AR Field City of Phoenix and ADOT Chip Seal Coat(SAM)

1978 Several AR patents

1985-88 AR Gap Graded & Open Graded Mixes

1993 ISTEA controversy 1994 ASTM Specification 1995 Patents expire

1997 RPA Formed

2000-2009 Three International AR Conf.

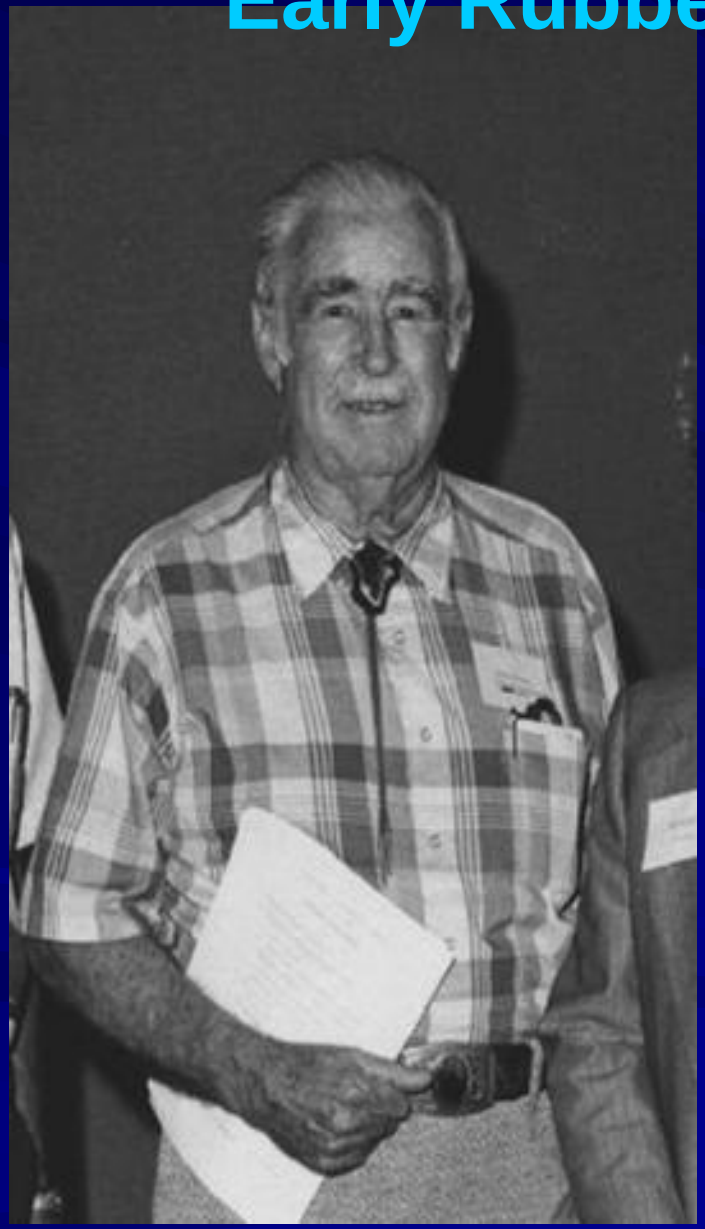
Charlie (center) at First National A-R Conf. 1980

Others: Dr. J. Love FHWA, Dr. J. Epps Tex A&M, Dr. B. Galloway TTI, Gene Morris ATRC

History of Crumb Rubber-Asphalt

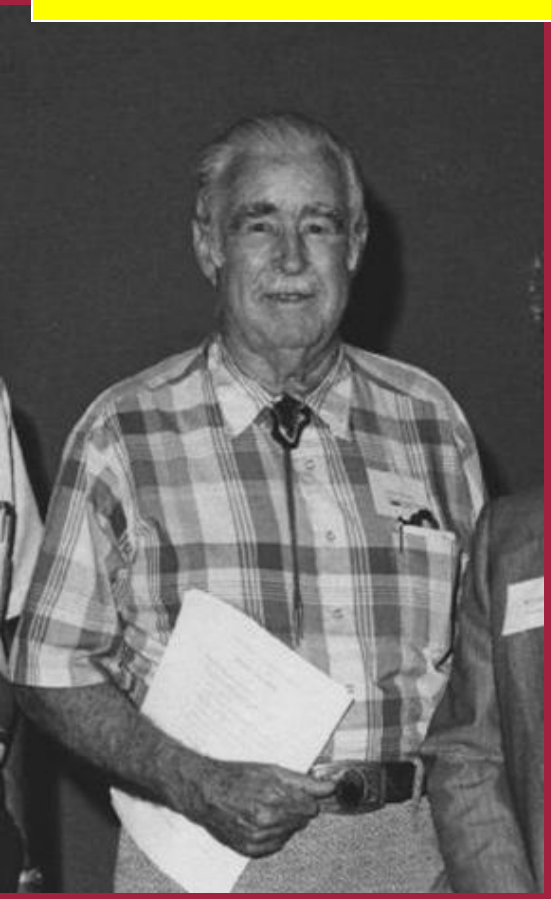
1920-1950's Pre-Rubber Asphalt
1960's Early Development
1970's Chip Seal Coats
1980's Gap Graded & Open Graded Mixes
1990's Politics & Starting Over
2000's Performance, Research, Environment, Costs
2010+ Market Changes, International Asphalt-Rubber PG Binder Grading, WMA

1960's Charles H. McDonald Early Rubber in Asphalt Development



- 1950's Used asphalt to patch cracked roof of trailer when travelling with US Bureau of Public Roads (now FHWA).
- Mixed in ground tire rubber while heated to increase flexibility.
- Created pot-hole "band aid" for City of Phoenix 1960s

Charles McDonald Inventor of Asphalt Rubber

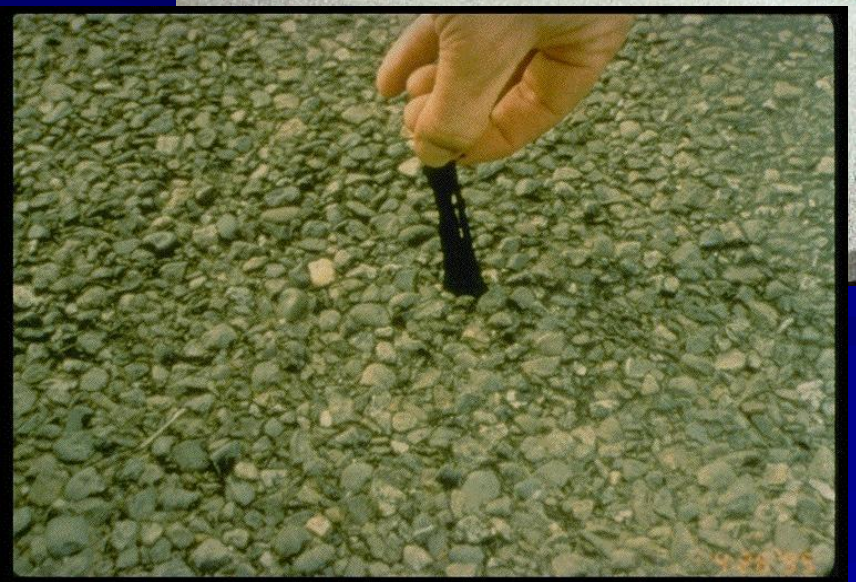


McDonald Applying AR Band Aid Patch Circa 1966

Asphalt Rubber Band Aid Patch Circa 1966

ARIZONA ASU • ADOT • Industry • Local Governments PAVEMENTS/MATERIALS CONFERENCE

Early Chip Seal Spreader Truck Technology Mid 1970s



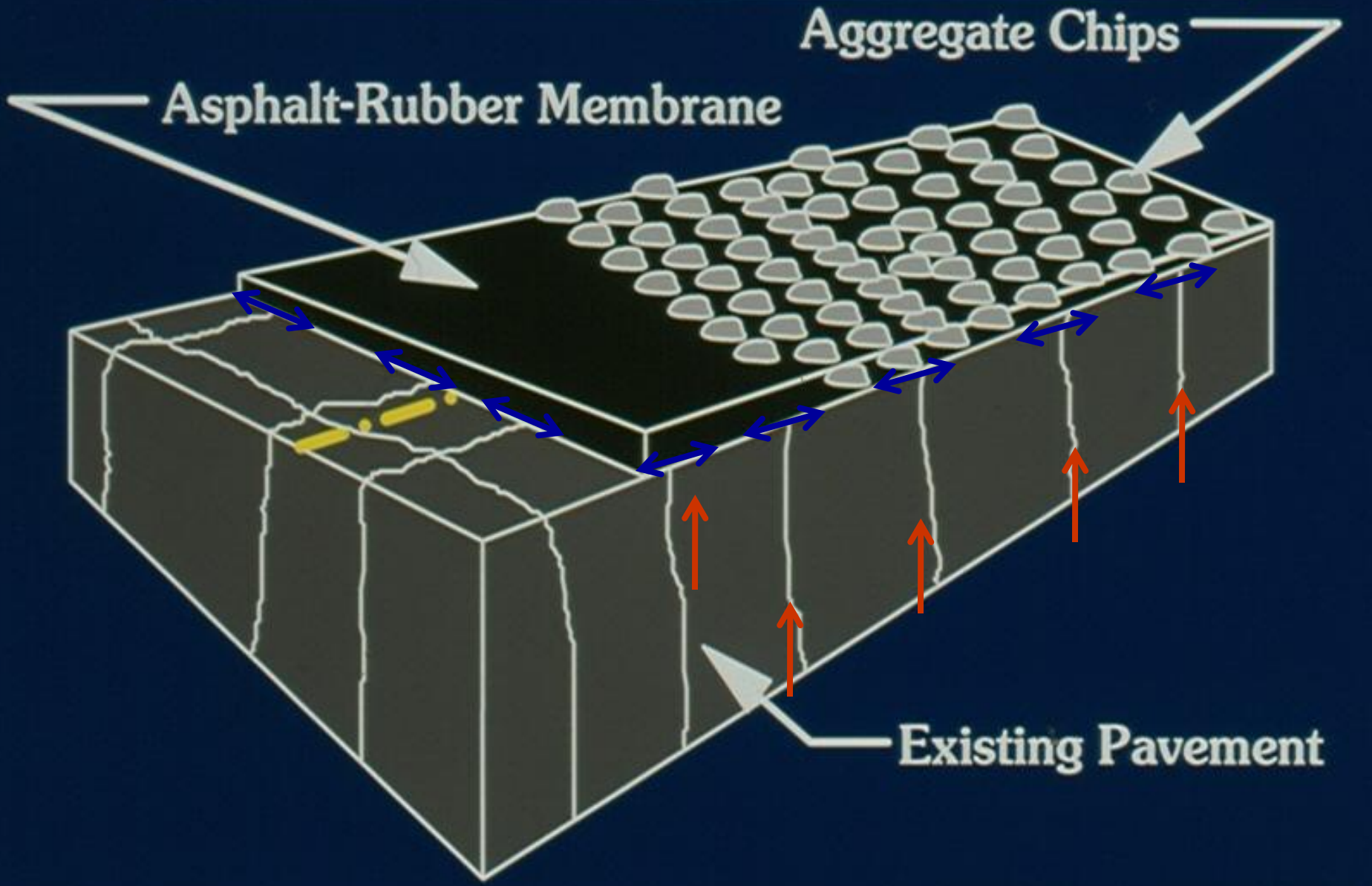
Early Hot Mix Application Placed 1975 Through Mid 1980's

Arizona AR SAM

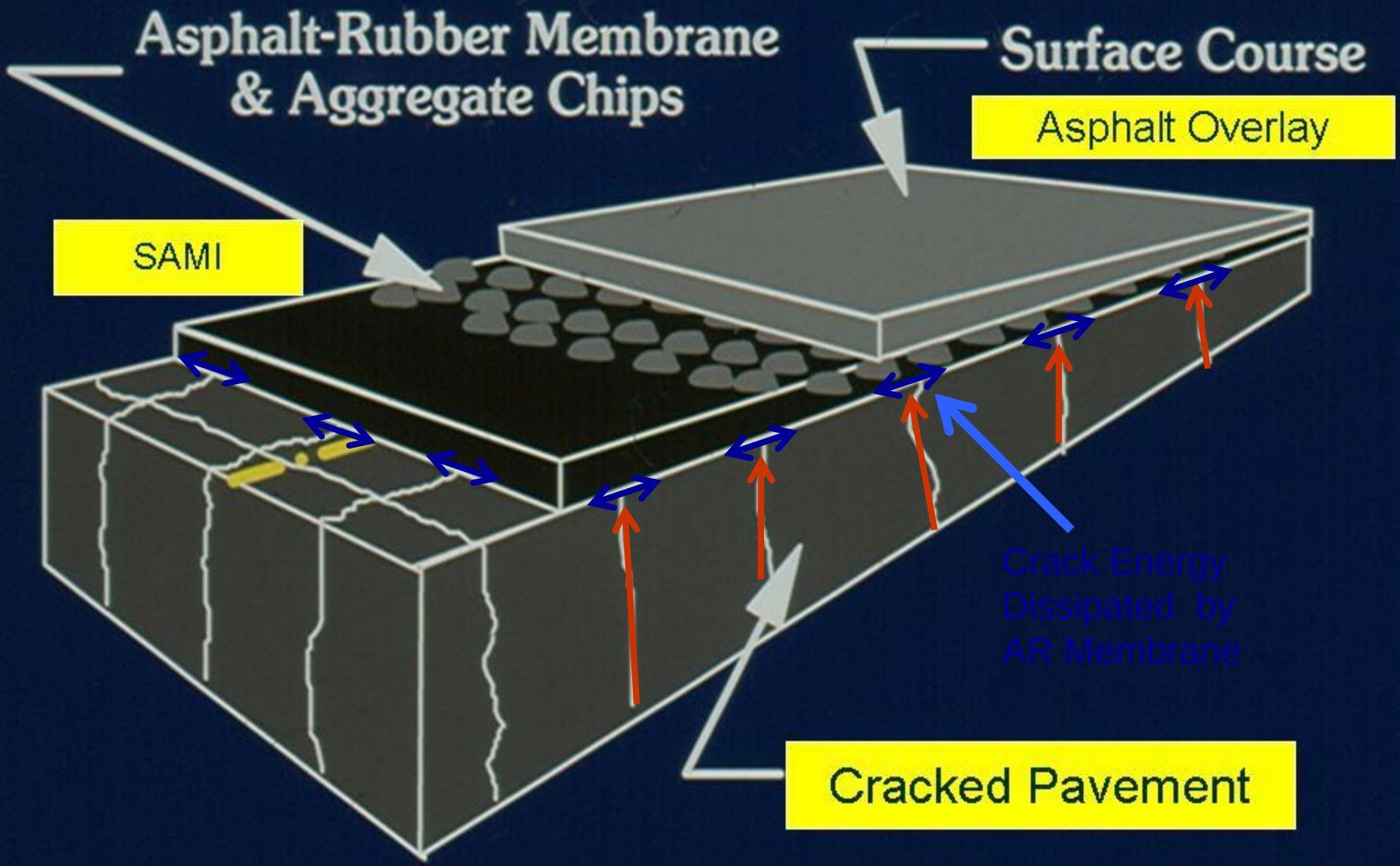
Belgium AR
Open Graded

South Africa AR SAM

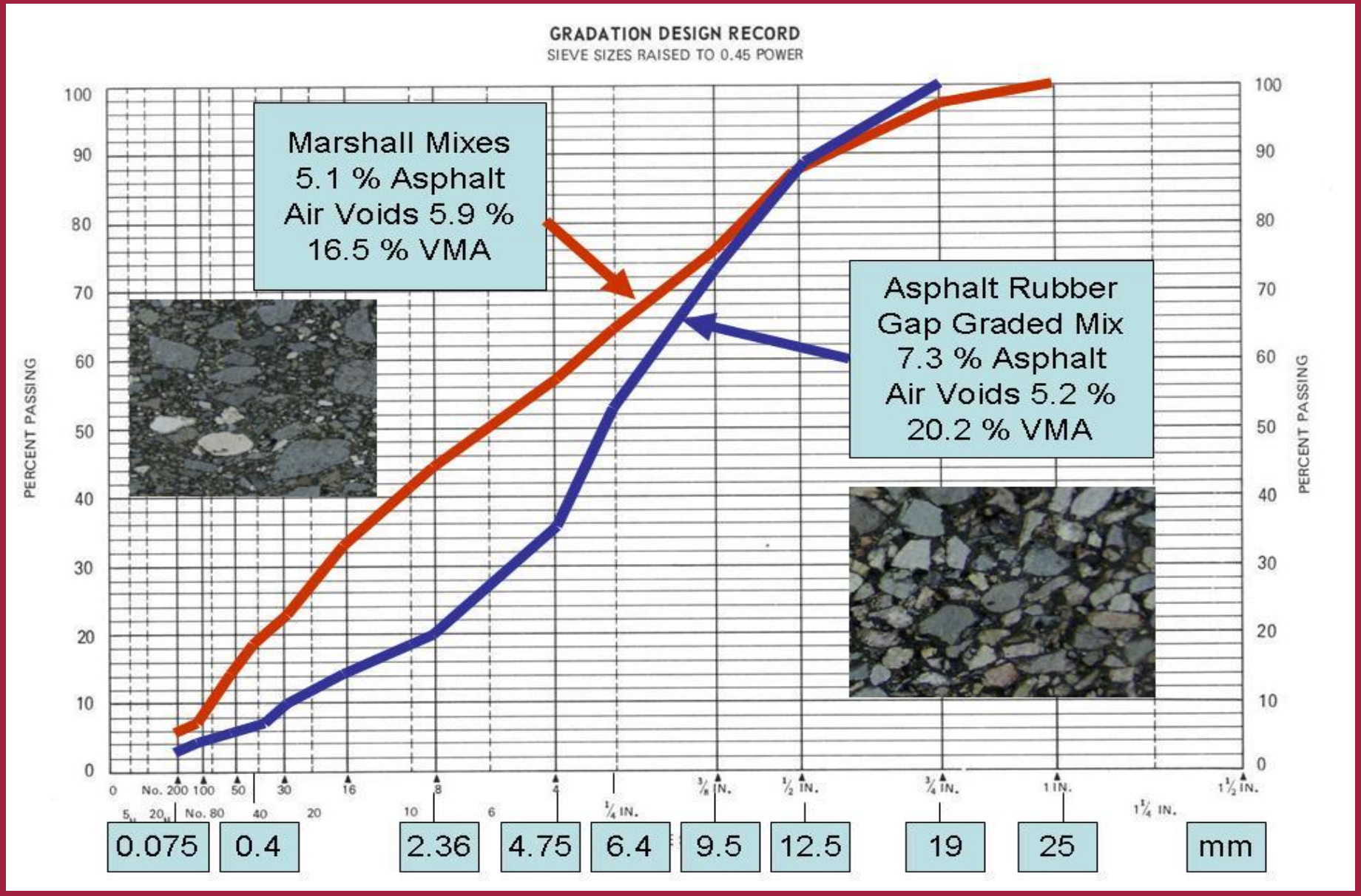
Stress Absorbing Membrane (SAM)



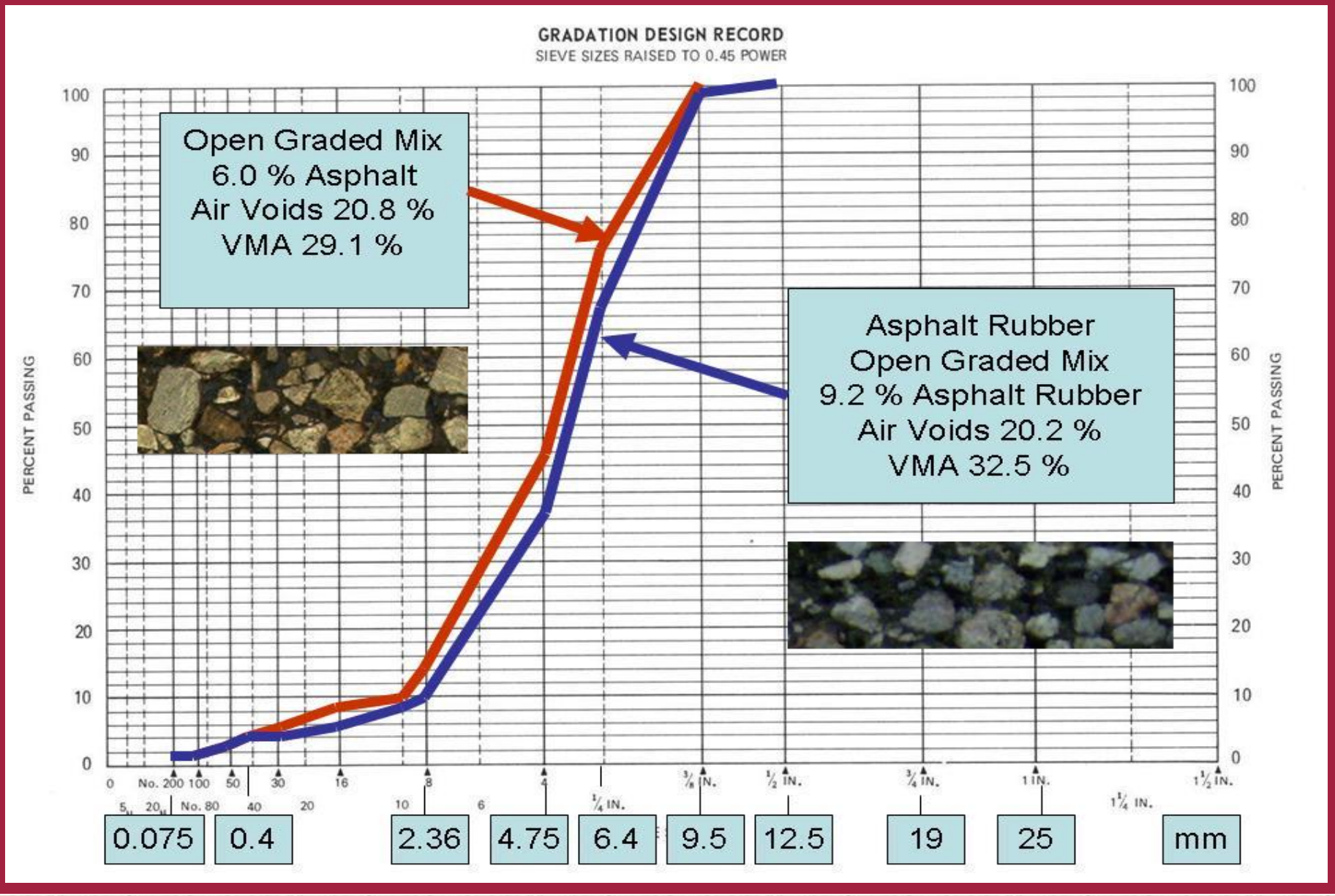
Stress Absorbing Membrane Interlayer (SAMI)



Asphalt-Rubber Binder Application



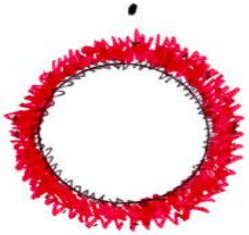
1980's Marshall Mix Gradation for HMA And Gap Graded Asphalt Rubber Mixes



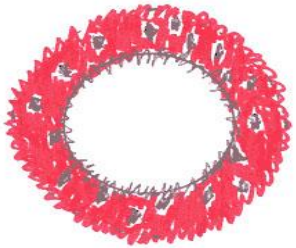
1980's Open Graded Mix Gradations

Film Thickness

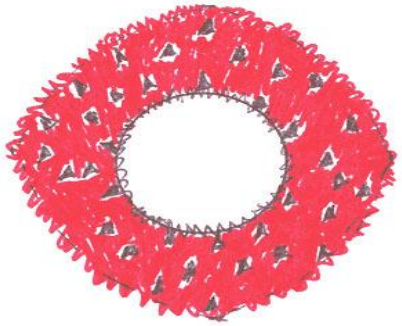
Dense Graded
HMA
9 Micron



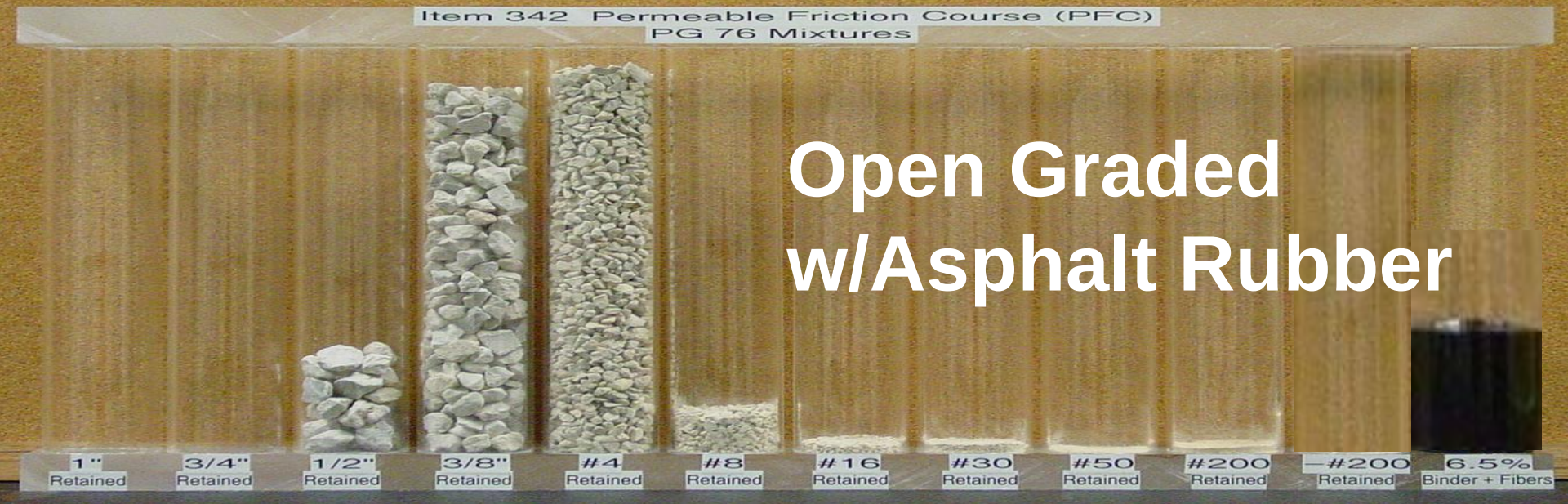
Gap Graded
Asphalt Rubber
18 Micron

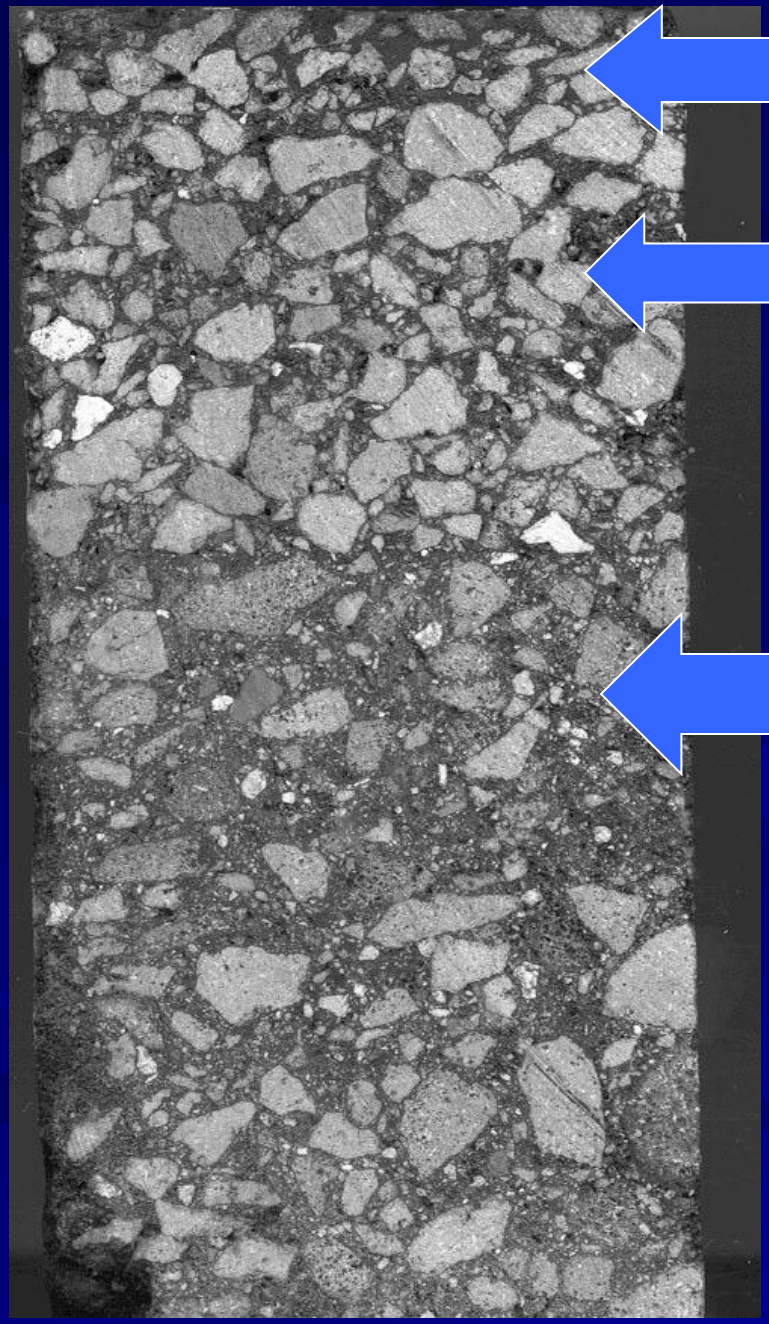


Open Graded
Asphalt Rubber
36 Micron



Example Dense-Graded HMA vs. AR Open

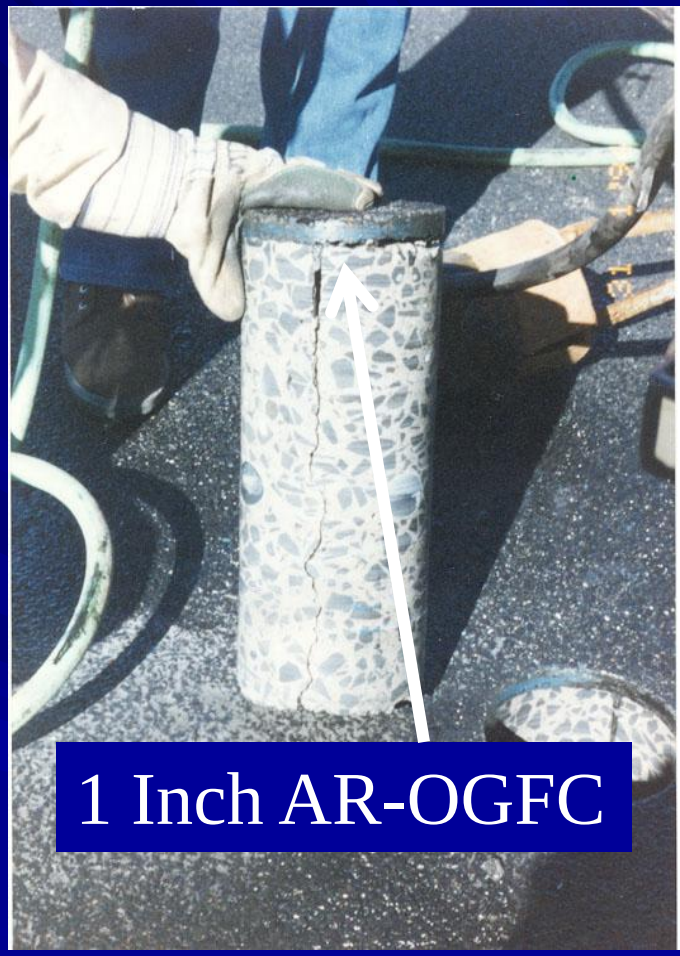




AR-OGFC

AR-AC

HMA
Base
Mix



Asphalt-Rubber Mixes

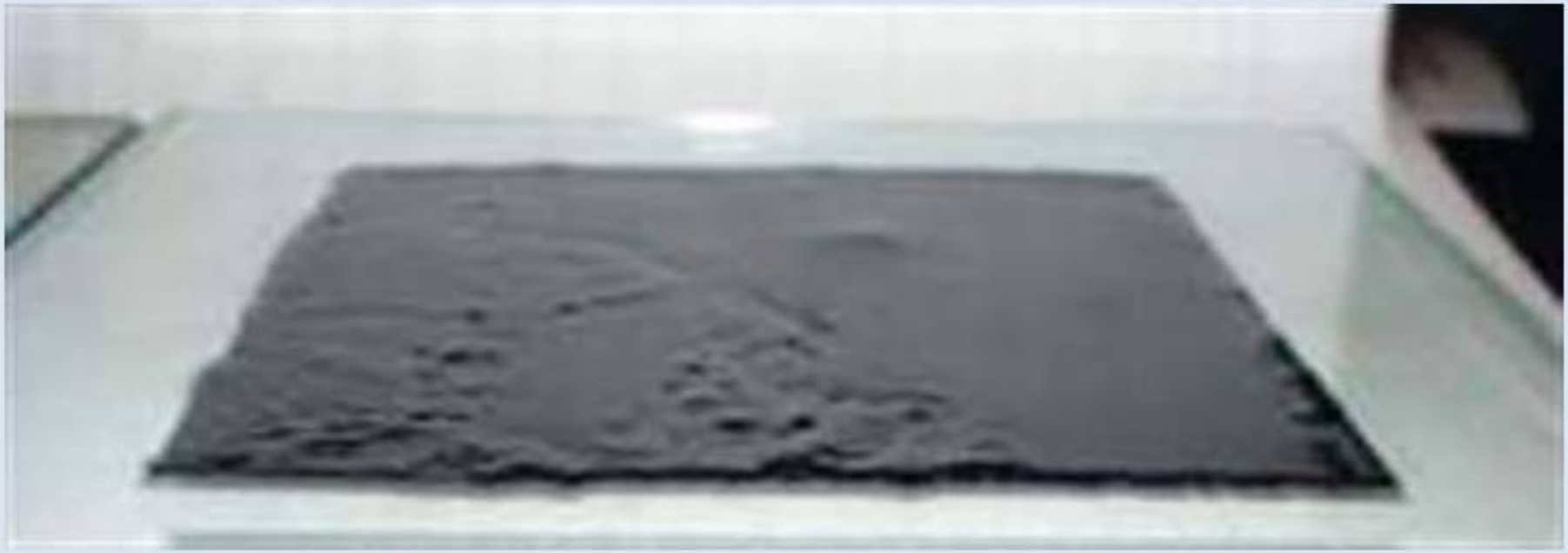
1994 ASTM AR Definition & Specification

Asphalt-Rubber as defined by ASTM D8, Spec. ASTM D6114

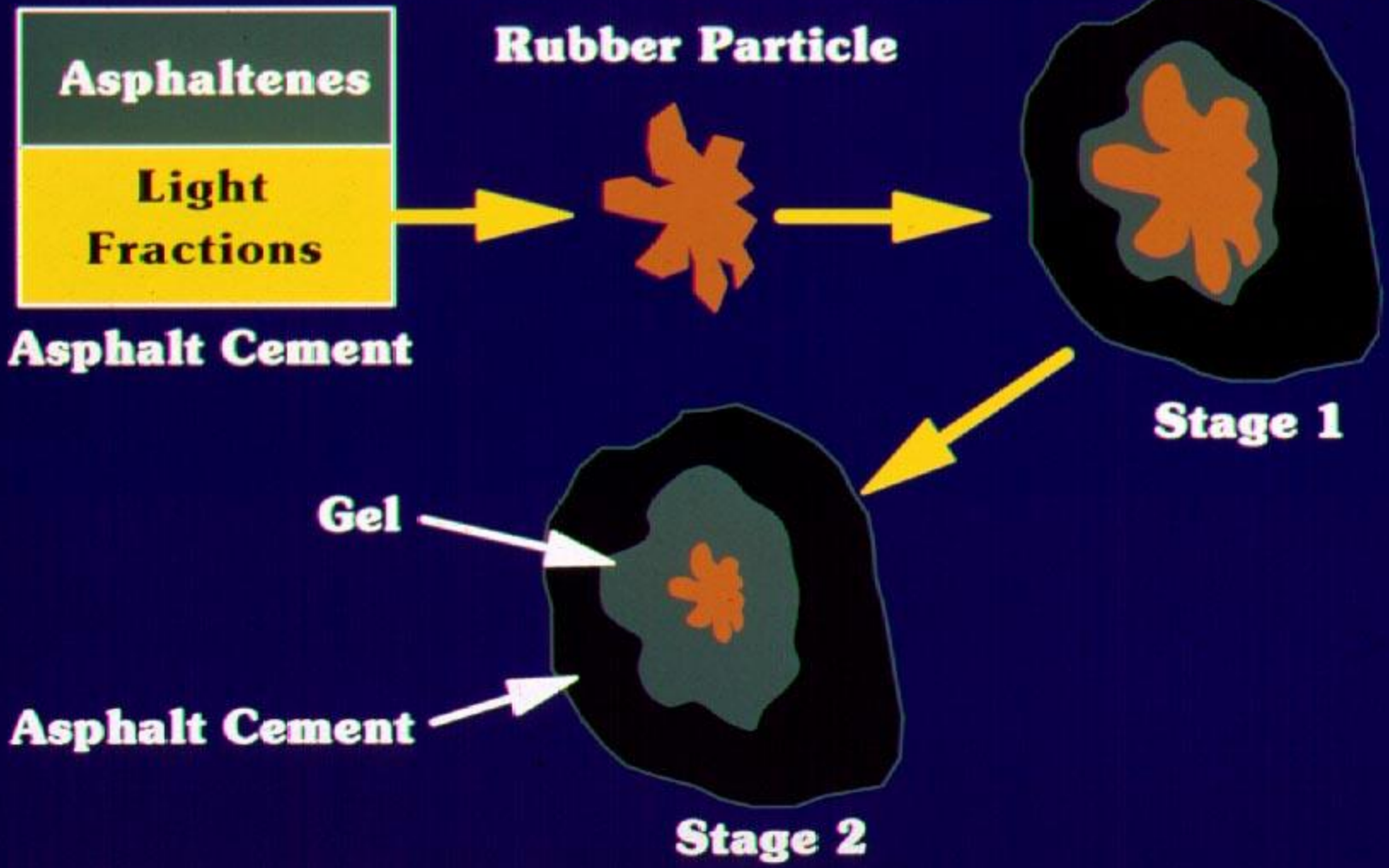
"Asphalt-Rubber is a blend of asphalt cement, reclaimed tire rubber and certain additives, in which the rubber component is at least 15% by weight of the total blend and has reacted in the hot asphalt cement sufficiently to cause swelling of the rubber particles."

Asphalt-Rubber Binder with Rubber Particles

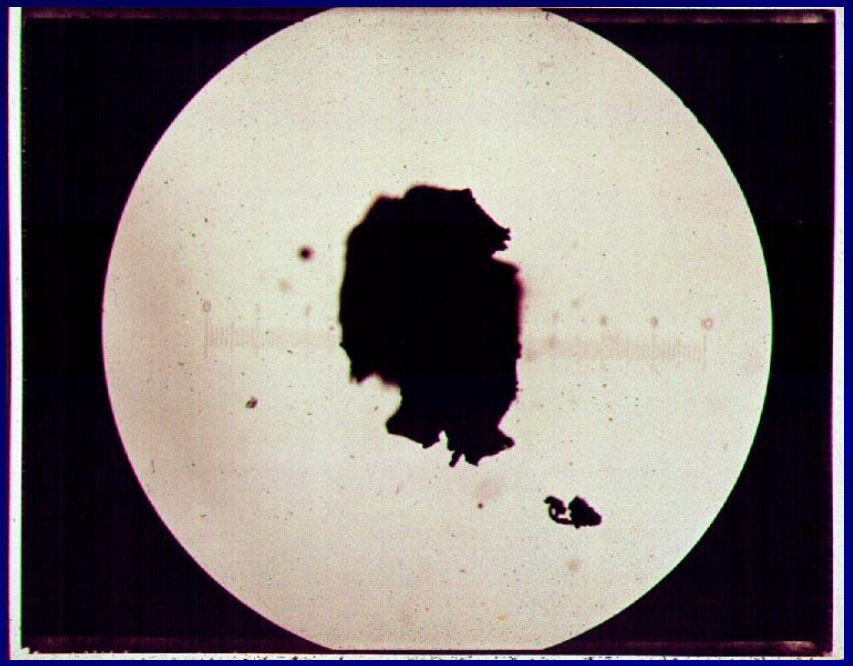
Asphalt Binder, Neat asphalt, Polymer Asphalt, Terminal Blend



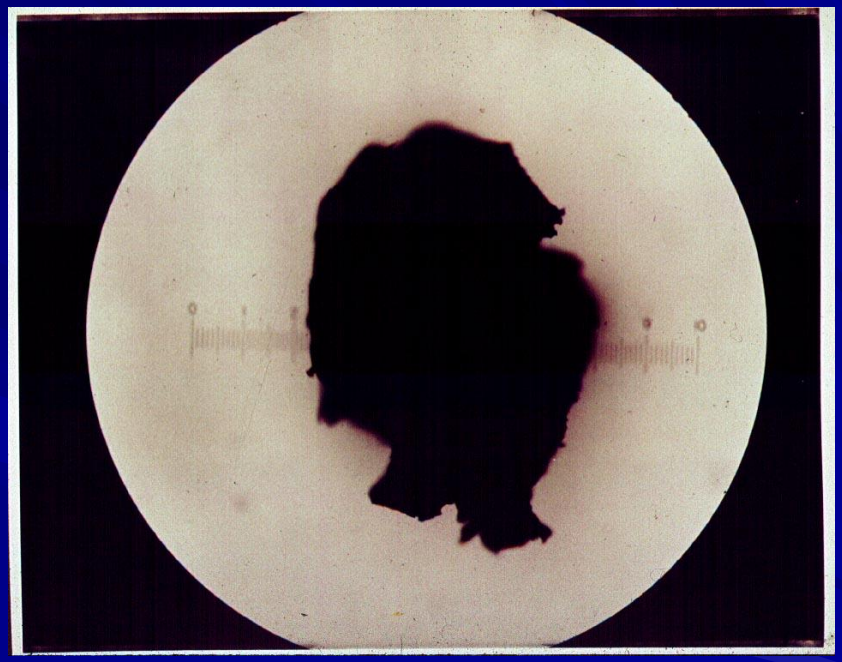
Reaction Stages of Asphalt & Rubber



Rubber Particle Interaction



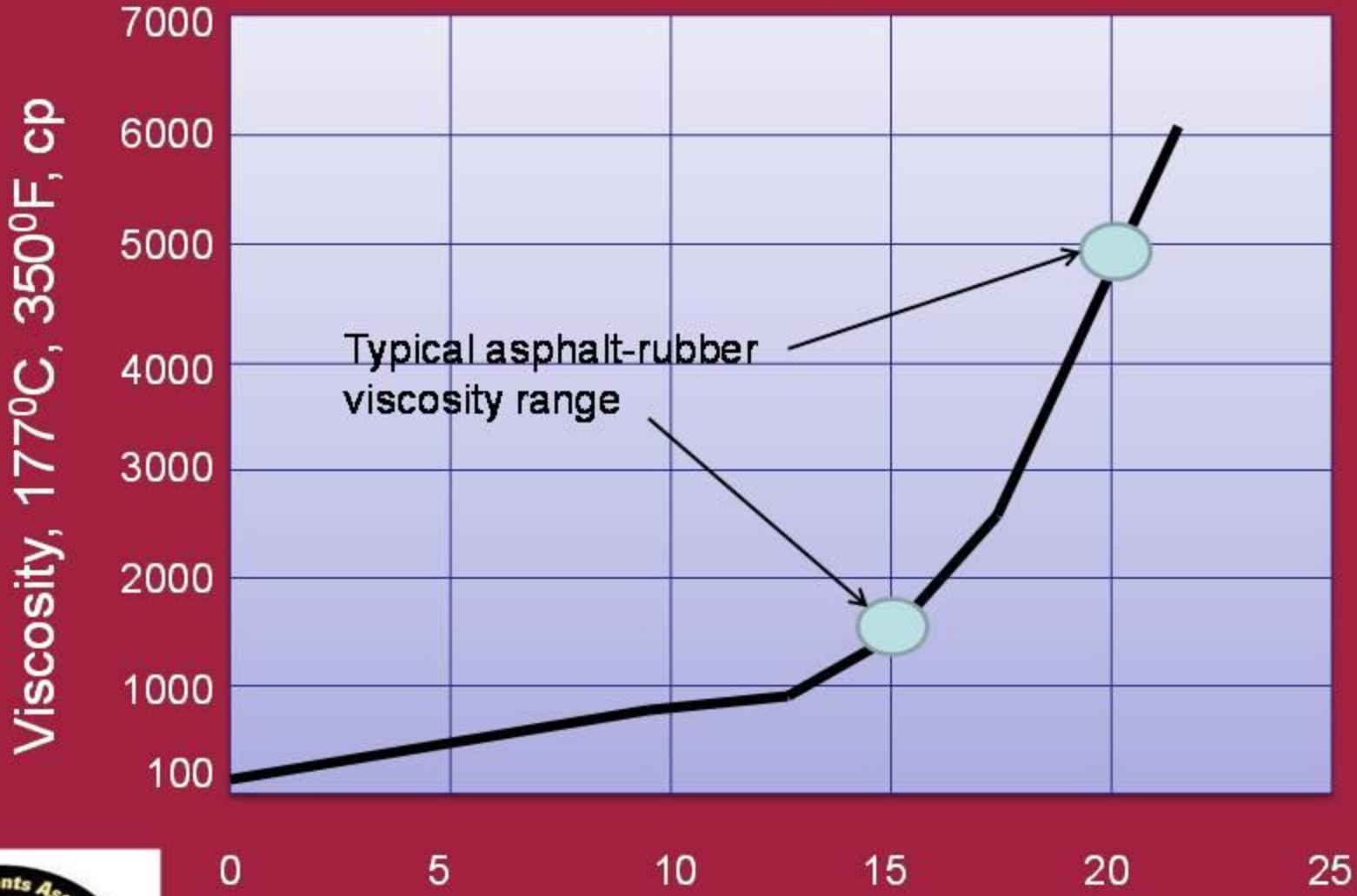
Before



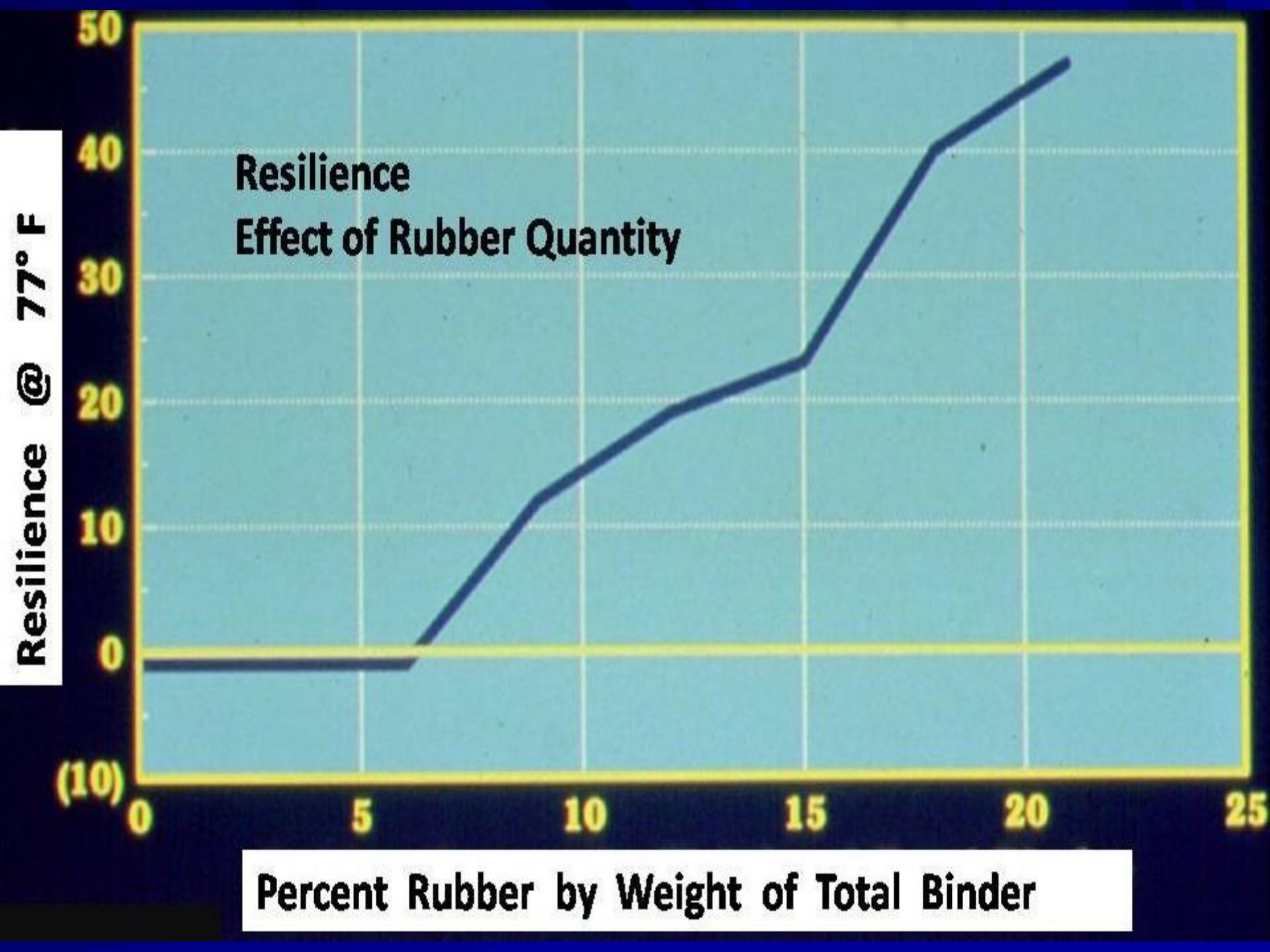
After

Quality Control Circa 1982

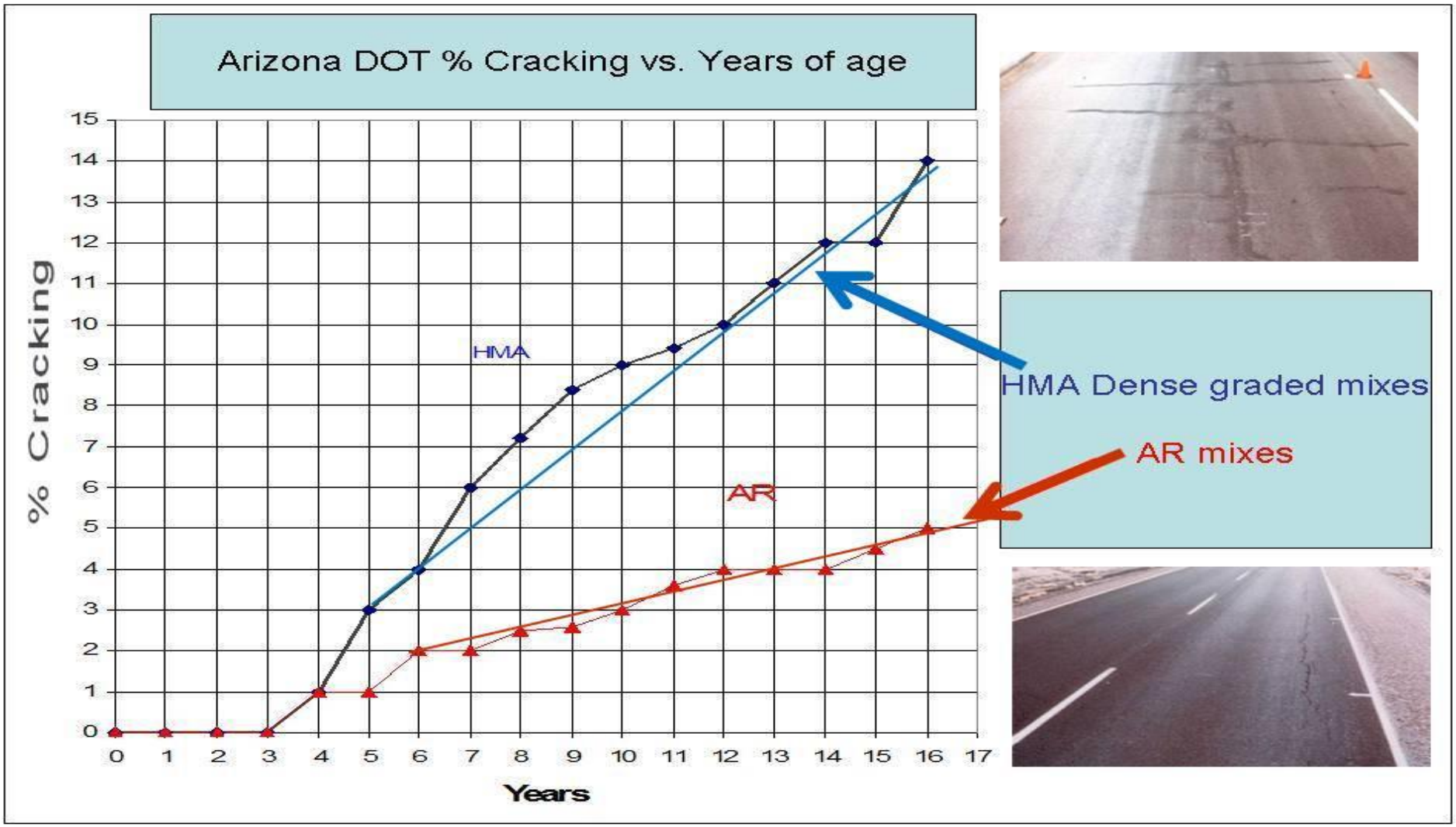
Effect Rubber Quantity, Rotational Viscosity

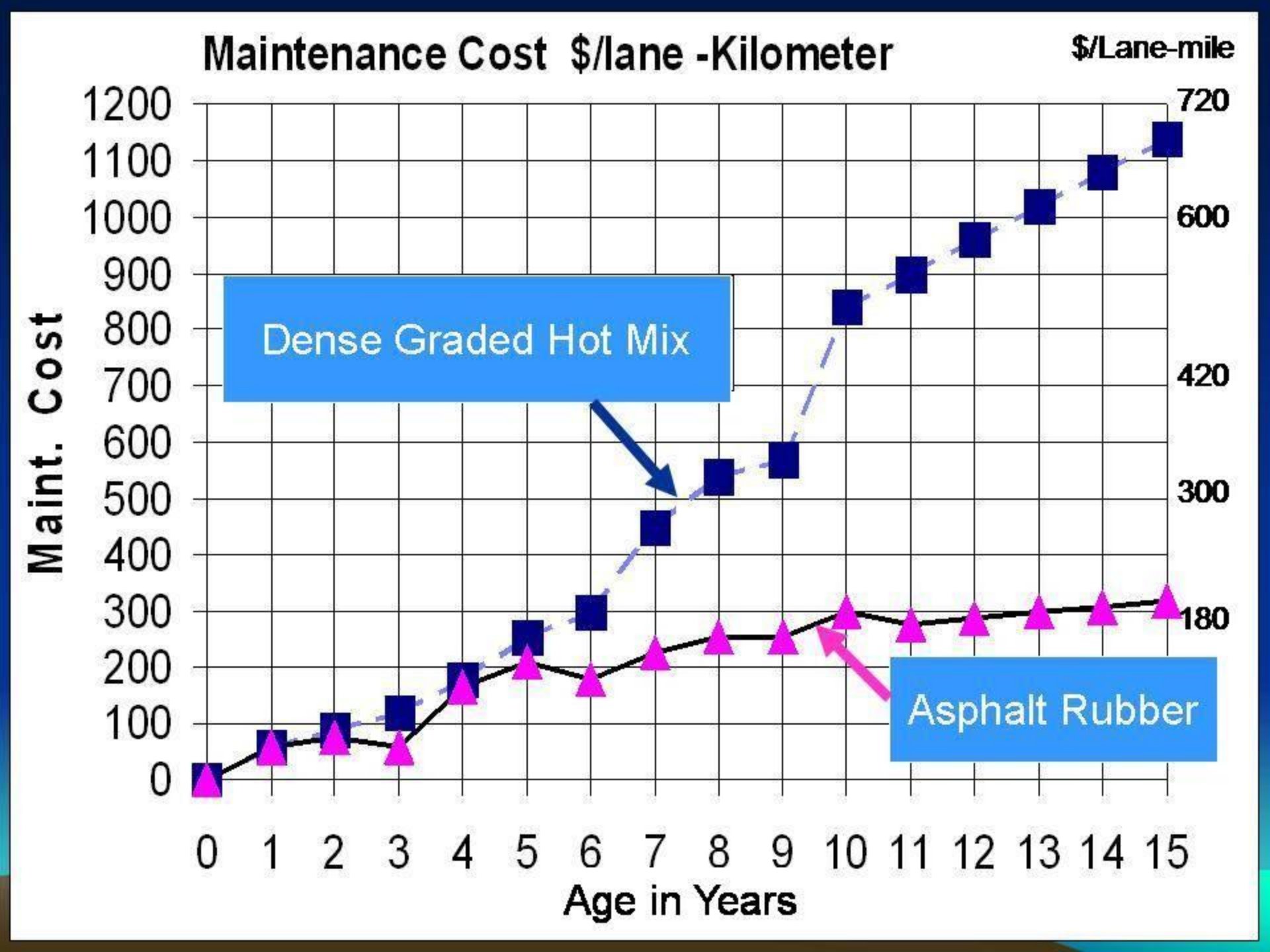


Rubber Pavements Association
Founded 1985


Resilience
Effect of Rubber Quantity
Resilience @ 77° F
50
40
30
20
10
0
(10)
0
5
10
15
20
25
Percent Rubber by Weight of Total Binder

2000's Performance, Research, Environment & Costs




Maintenance Cost $/lane -Kilometer
$/Lane-mile
Maint. Cost
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
720
600
420
300
180
Dense Graded Hot Mix
Asphalt Rubber
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Age in Years

Arizona Quiet Pavement Program

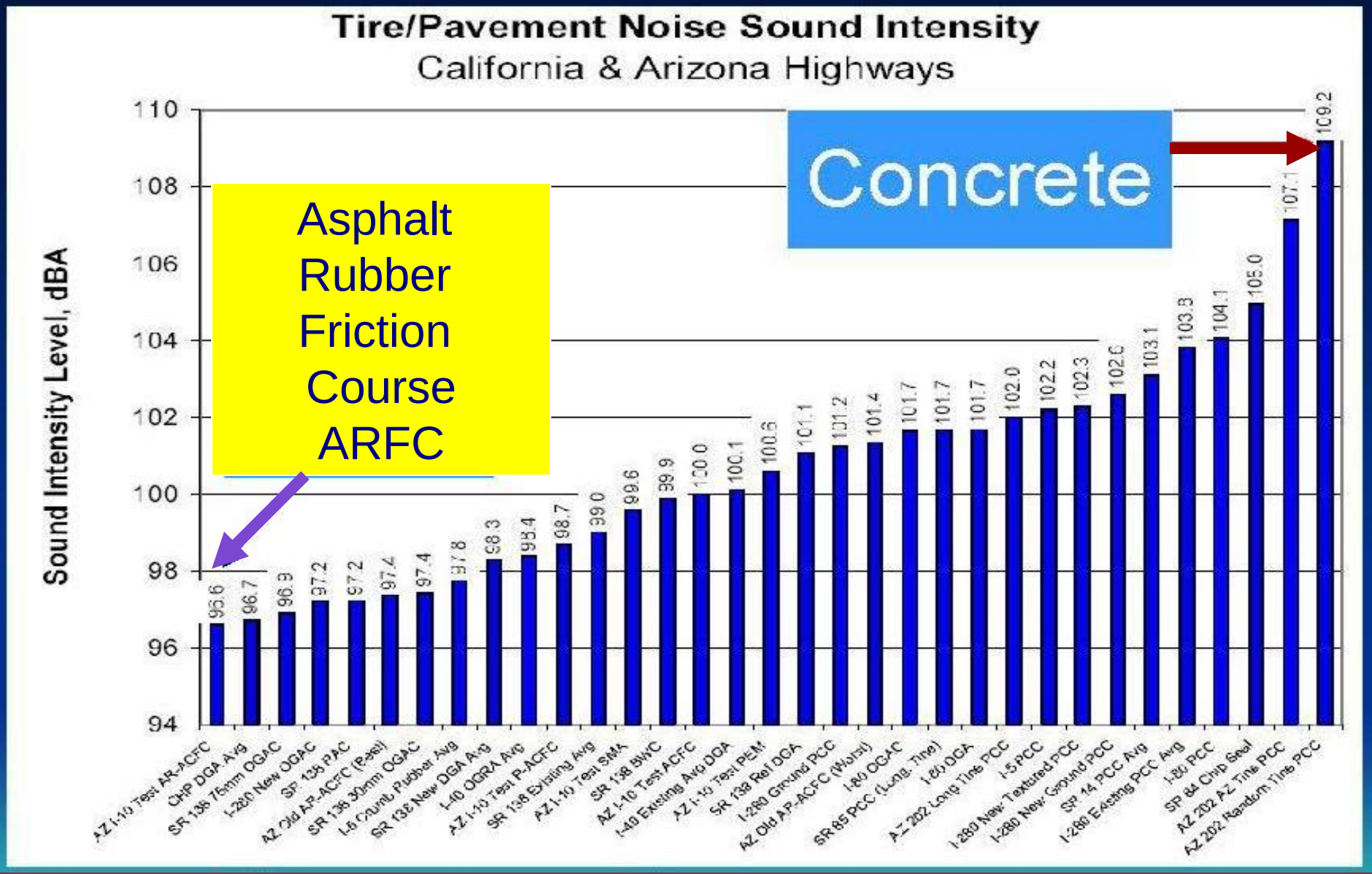
ADOT Adoption of Quiet Pavement Program to Reduce Noise From Concrete Pavement

- Adoption of QPP Due to Less Noise From Asphalt-Rubber
- Citizens Noted Less Noise From AR Open Graded Course
- AR Open Graded Course 25 mm Thick
- ADOT Conducted Numerous Research Studies on Noise Reduction Benefits of ARFC Starting in 1995
- ADOT Completed a Noise Study in January 2002 on a Concrete Test Section of SR 101 Overlaid With ARFC
- ADOT Started the QPPP in April 2003, in Accordance With An Agreement Between FHWA and ADOT

Arizona Quiet Pavement Program

Location	Concrete Before	ARFC After	Decrease
Shoulder (15m)	79.8	72.6	7.2
Soundwall (30m)	76.6	67.1	9.5
Residential (120m)	51.7	45.6	6.1

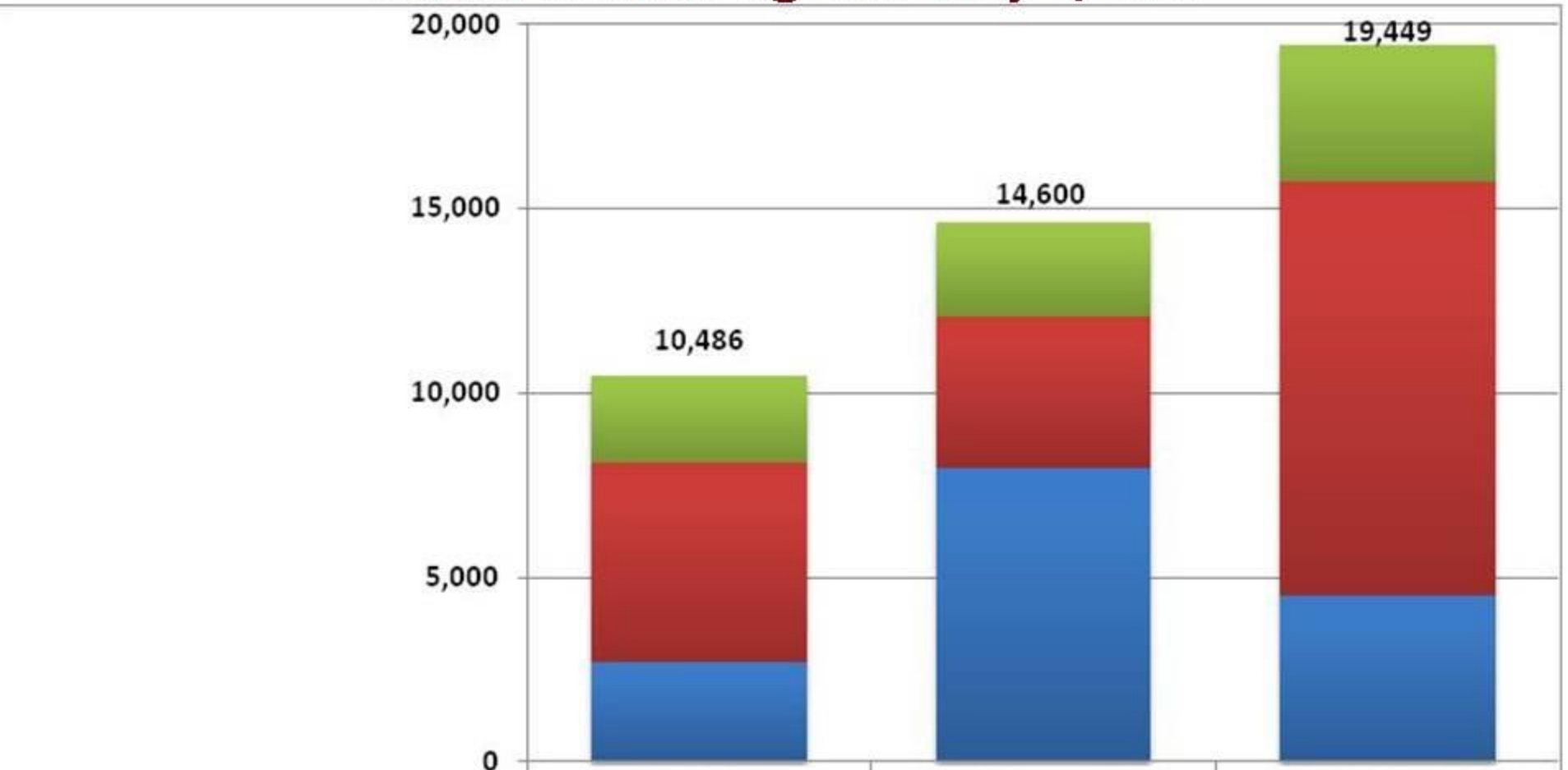
Asphalt-Rubber Noise Reduction – Noise Testing Equipment – On Board Sound Intensity (OBSI)



Asphalt Rubber Open Graded
Quietest Surface


Overlay with
Asphalt Rubber
PLAZA
Concrete
Pavement

Total Annual kg CO2 Eq. / km



	AR 50mm, Base 150mm	UTW 50mm, HMA 50mm, Base 150mm	HMA 100mm, Base 150mm
Transportation kg An. CO2 Eq. / km	2,386	2,526	3,722
Mixing kg An. CO2 Eq. / km	5,381	4,124	11,210
Production kg An. CO2 Eq. / km	2,718	7,951	4,517

Recycling of Asphalt-Rubber Mix 2007

ARFC Hot Plant
Recycled mix into
I-19 Frontage Road

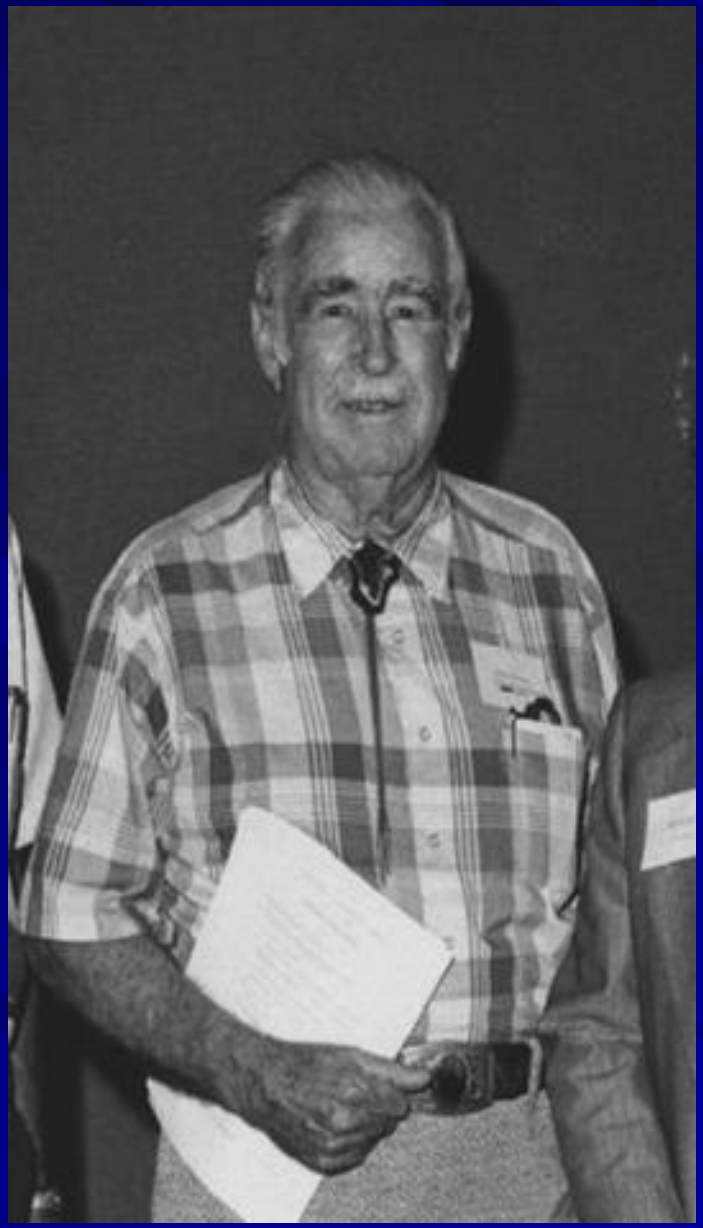
ARFC Recycled in
Place on I-19, note
Joint cracks

Asphalt Rubber Benefits

Less Reflective Cracking
Less Maintenance/More Durable
Less Raveling
Good Rut Resistance
Good Skid Resistance
Smooth Ride
Good in hot & cold climates
Less Splash & Spray Better Drainage
Less Noise
Cost Effective
Engineering Use for Old Tires

Sustainable Green Material

Charles H. McDonald



Bill Brake –
Sahuaro Asphalt & Petroleum
/Edgington Oil

Don Nielsen,
Chairman of the Board
Arizona Refining
Company
/Union Oil Comp

Gene Morris –
ADOT Research Engineer

William “Bill” Price
ADOT State Engineer

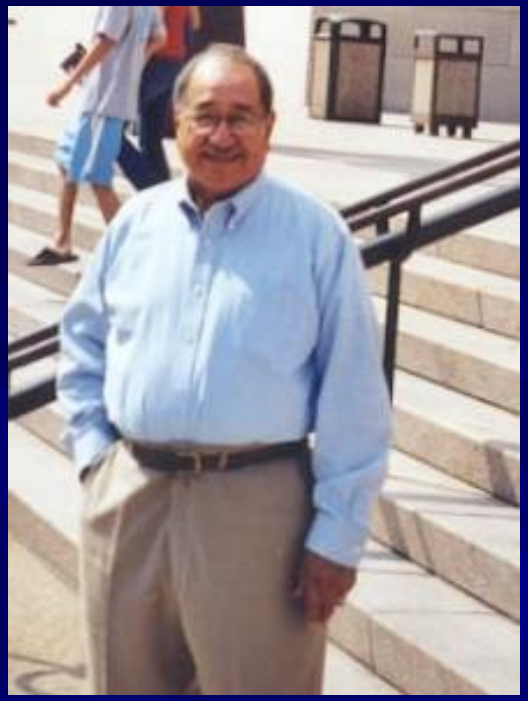
Fred Glendenning, Director of Public Works for the City of Phoenix

Donna Carlson
RPA – Past Director

Doug Carlson
RPA – Past Director

Mark Belshe
RPA – Present Director

Supporters of Asphalt Rubber



Joe Cano –
City of Phoenix

Anne Stonex –
Industry

Doug Forstie –
ADOT

And Many, Many More

Asphalt Rubber Companies, Rubber Suppliers and Organizations

Sahuaro Petroleum and Asphalt Co. – Bill Brake
Arizona Refining Company – Don Nielsen
BearCat – Ken Hill
Crafco – Bill Brake, Fred McWeeny, Ken Hill, Carl Jacobson, E.J.Johnson
International Surfacing Inc. – Carl Jacobson
International Surfacing Systems – Jeff Reed

Asphalt Rubber Companies, Rubber Suppliers and Organizations

Atlos Rubber – Bob Winters
Genstar – Fernly Smith
Baker Southwest – Tim Baker
PolyTeK Southwest/Neste – Mike Masson
Landstar Rubber Inc. – D. Elroy Fimrite
CRM – Barry Takalou

Asphalt Rubber Companies, Rubber Suppliers and Organizations

1985 - Present

Asphalt Rubber Producers Group – Russ Schnormier, Gary Cooper – Al France

Rubber Pavements Association – Donna Carlson – Doug Carlson - Mark Belshe

Other Supporting Agencies, Funding, Research, Projects

Arizona Department of Transportation
City of Phoenix
Federal Highways Administration
University of Arizona
Arizona State University
And many, many more

Future of Rubber in Asphalt
Rubberized Asphalt

- Asphalt-Rubber – 15 % or more recycled tire rubber in the asphalt
- Asphalt-Rubber Light – Less than 15% recycled tire rubber in the asphalt
- Rubberized Asphalt Binder - Combination of recycled tire rubber and polymer in the asphalt
- Rubberized Asphalt Activated - Combination of recycled tire rubber and charged particles in the asphalt

2010+ Market Changes, International

- Cost of Asphalt
- Cost of Polymer
- Availability of Polymer
- Tighter Highway Funding Budgets
- Pavement Preservation Needs
- Thinner Pavements and/or Surface Treatments
- Reasons to Consider Rubberized Asphalt
- with GTR

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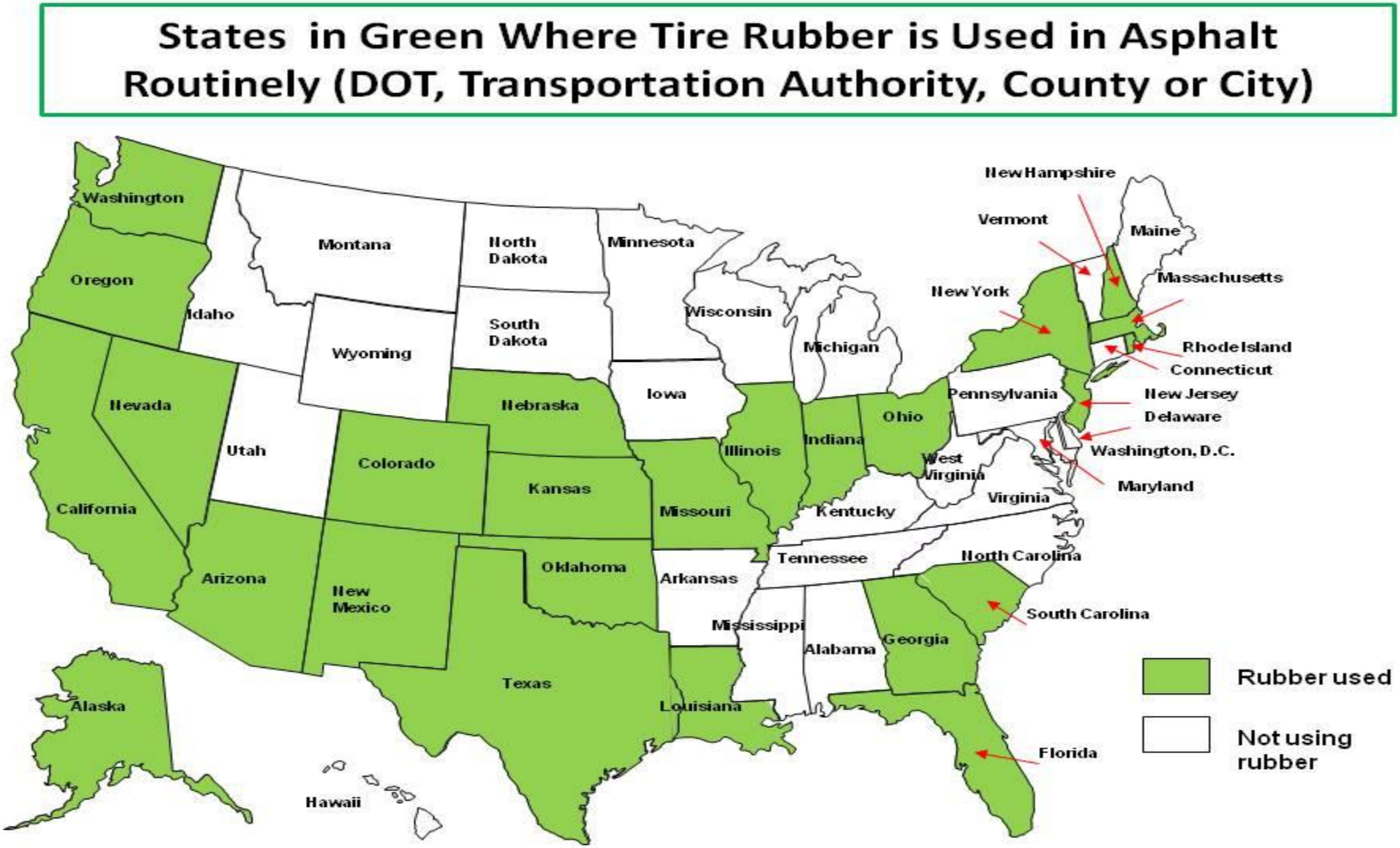
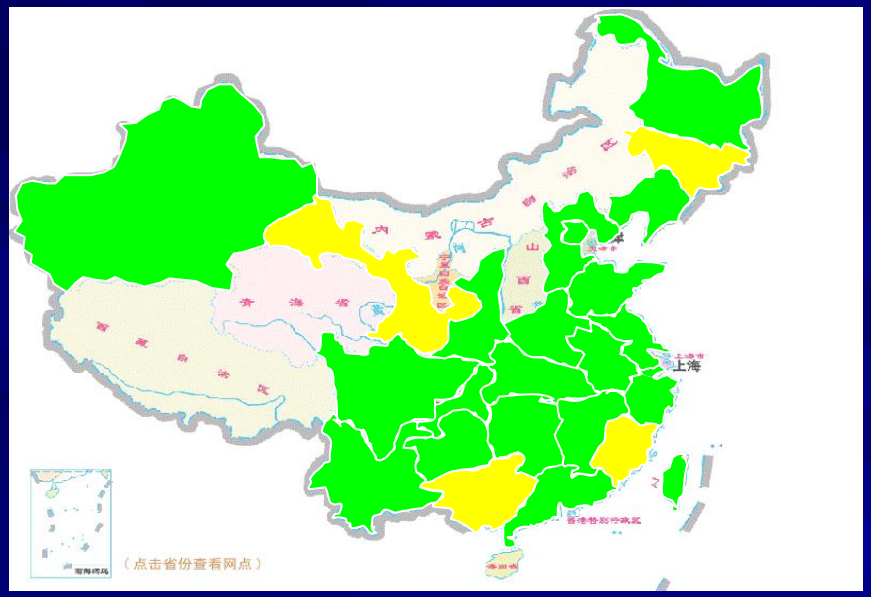
Where Rubber in Asphalt is specified and used in some form of pavement appliction



Use of asphalt rubber in China in 2010



Provinces which used AR

Provinces which plan to use

- Among the 34 provinces (autonomous regions and municipalities directly under the central government) in China, ah\bout 22 provinces have used or are using asphalt rubber, and about 4 provinces plan to use asphalt rubber next year.
- Until 2010, projects asphalt rubber may exceed 1500km, and about 100 thousand tones asphalt rubber has been used.

Brazil AR Project RJ 122 – IRF 2012 Award

- PAVEMENT CONDITIONS BEFORE AND AFTER THE REHABILITATION JOB WITH AR:

Thanks

For more information

www.rubberpavements.org

www.RA-Foundation.org

Rubber Pavements Association

Founded 1985

RAF

Rubberized Asphalt Foundation