Asphalt Emulsion Basics

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THE KING

DELTA BLUES


10
13
9

CREDIT

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Overview of Asphalt Emulsion

TRB Circular E-C102

Moving Asphalt

Heated

Cutback

Emulsified

HOT

Safety hazard

Requires continual heat source

Consistent properties

Very familiar

Storage stable

Cutback

Extreme fire hazard

Environmental issues

Mobile, far less heat required

Great penetrating, mixing and coating properties

Emulsion

Challenging physics

Property migration

Safe

Environmentally friendly

Designer properties

Emulsion Advantages

Aggregates do not need to be dry

Lower viscosity allows cracks and voids to be filled

Emulsion Advantages

Water based product requires lower energy usage to modify the asphalt

When solvents are desired, the amount necessary can be much less than cutbacks

Emulsion Advantages

Lower viscosities provide the ability for use at lower temperatures

Reduced Emissions

Reduced Energy Consumption

Smaller Carbon Footprint

Definition

A dispersion of small droplets of one liquid in another

Milk **Paint** **Cosmetics**
Butter **Mayonnaise**

Asphalt Emulsions

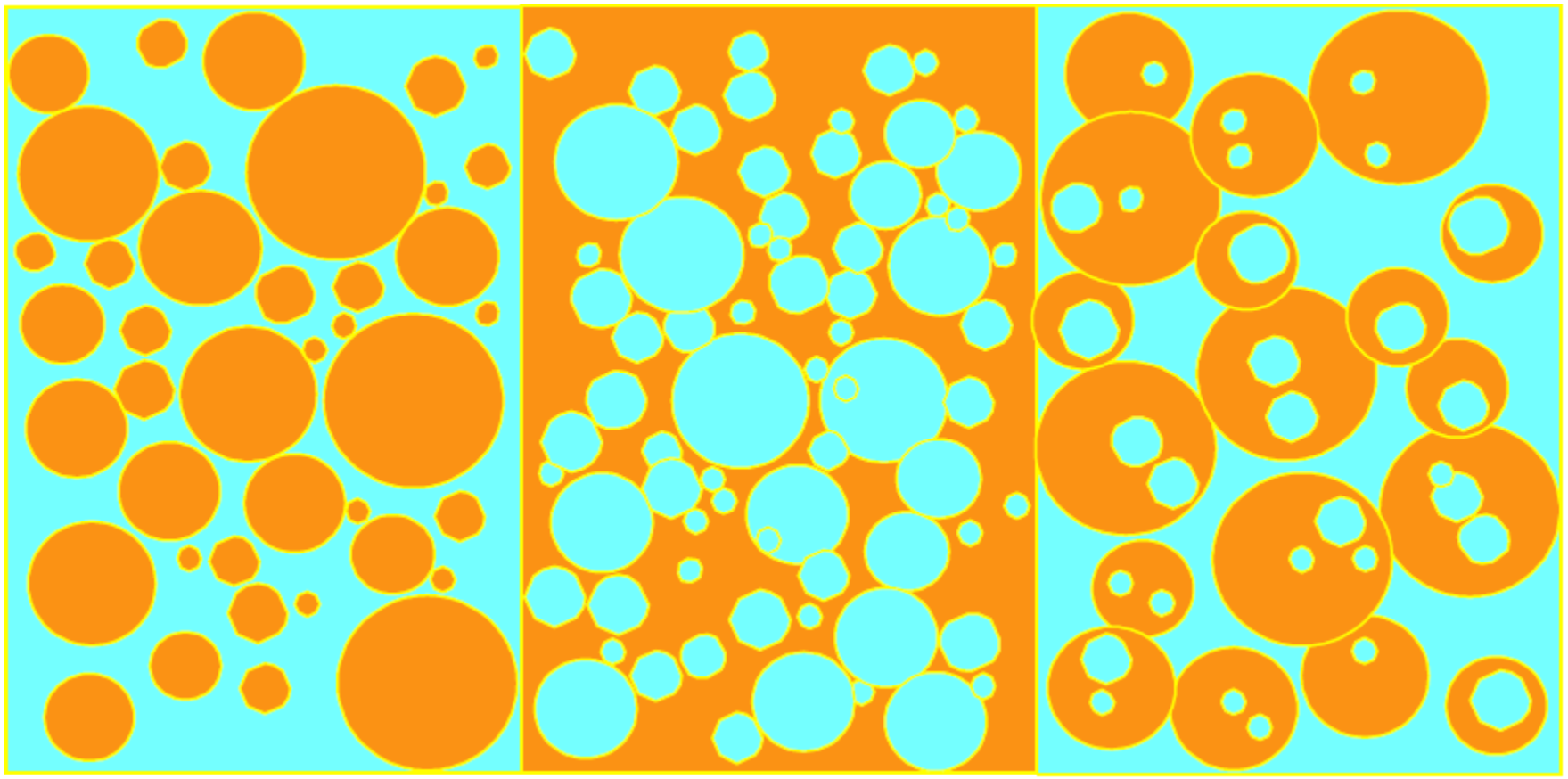
Usage began in early 20th Century

Comprise between 5-10% of “paving grade” asphalt used worldwide

Also used in other industries

- Automobile manufacturing
- Pipe Coating

EMULSION TYPES

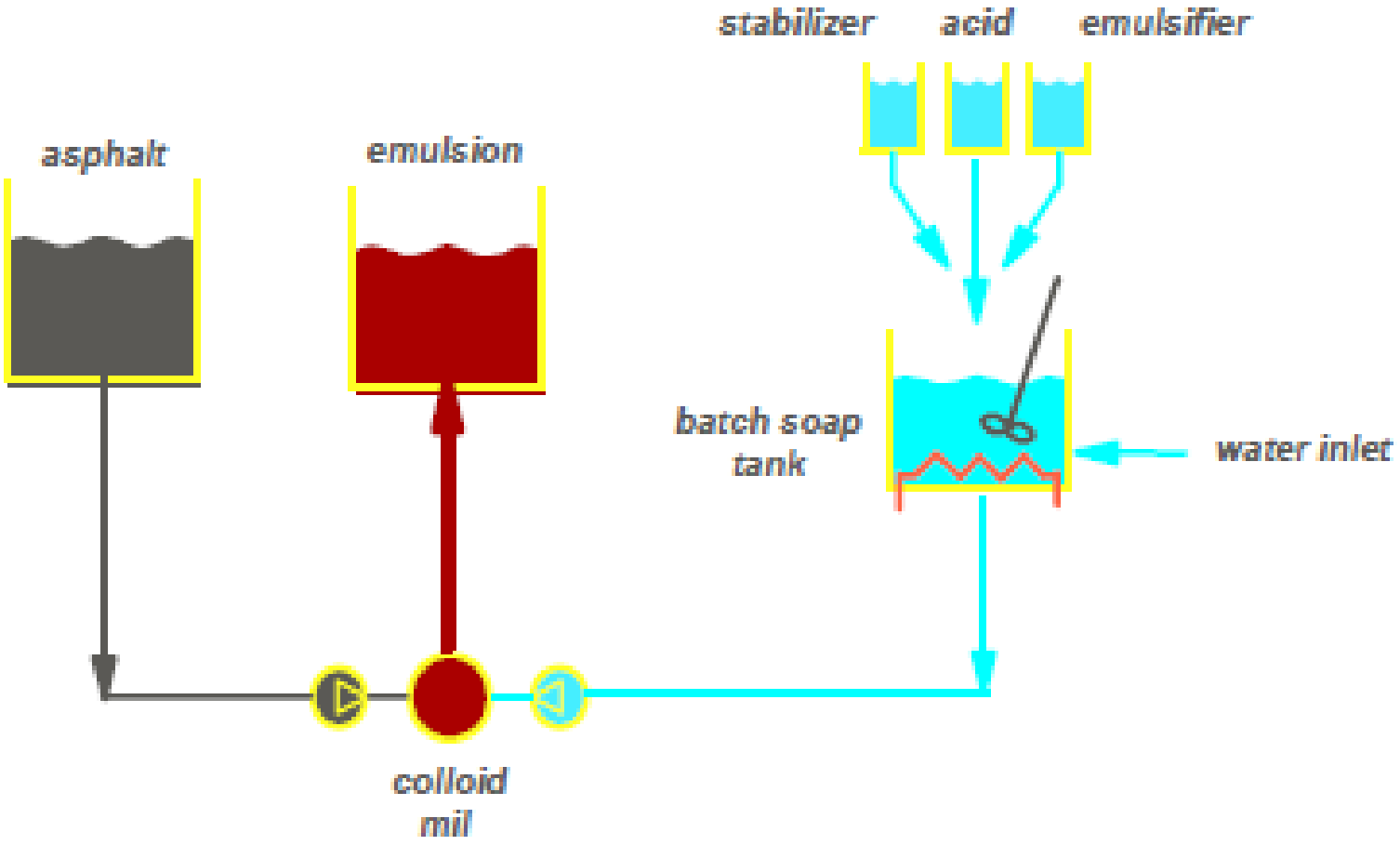


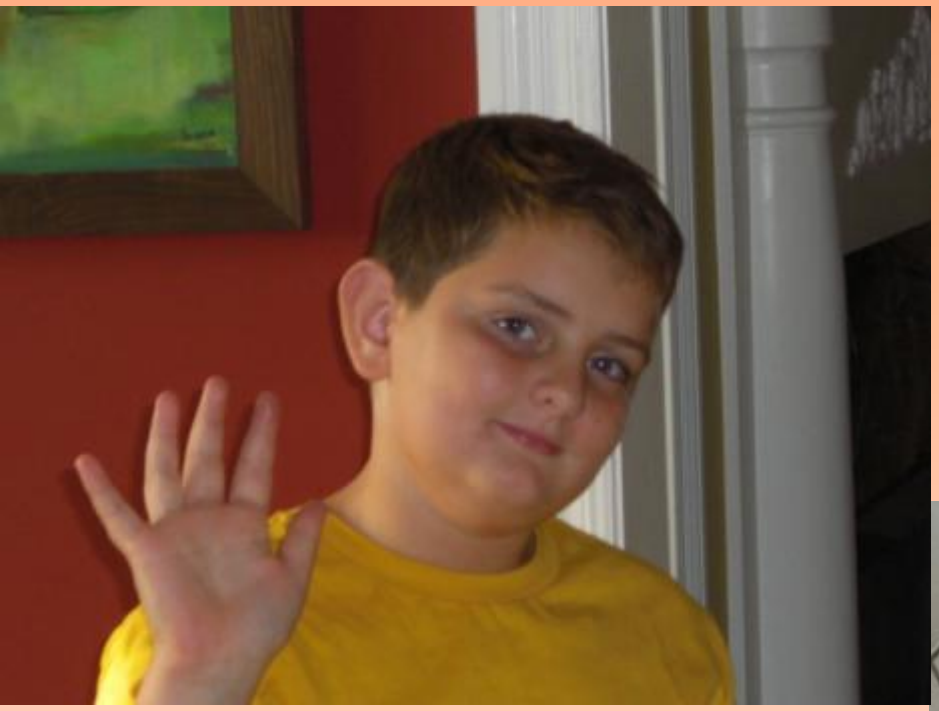
O/W W/O W/O/W

Components

Asphalt	40-75%
Emulsifier	0.1-2.5%
Water, additives	remainder

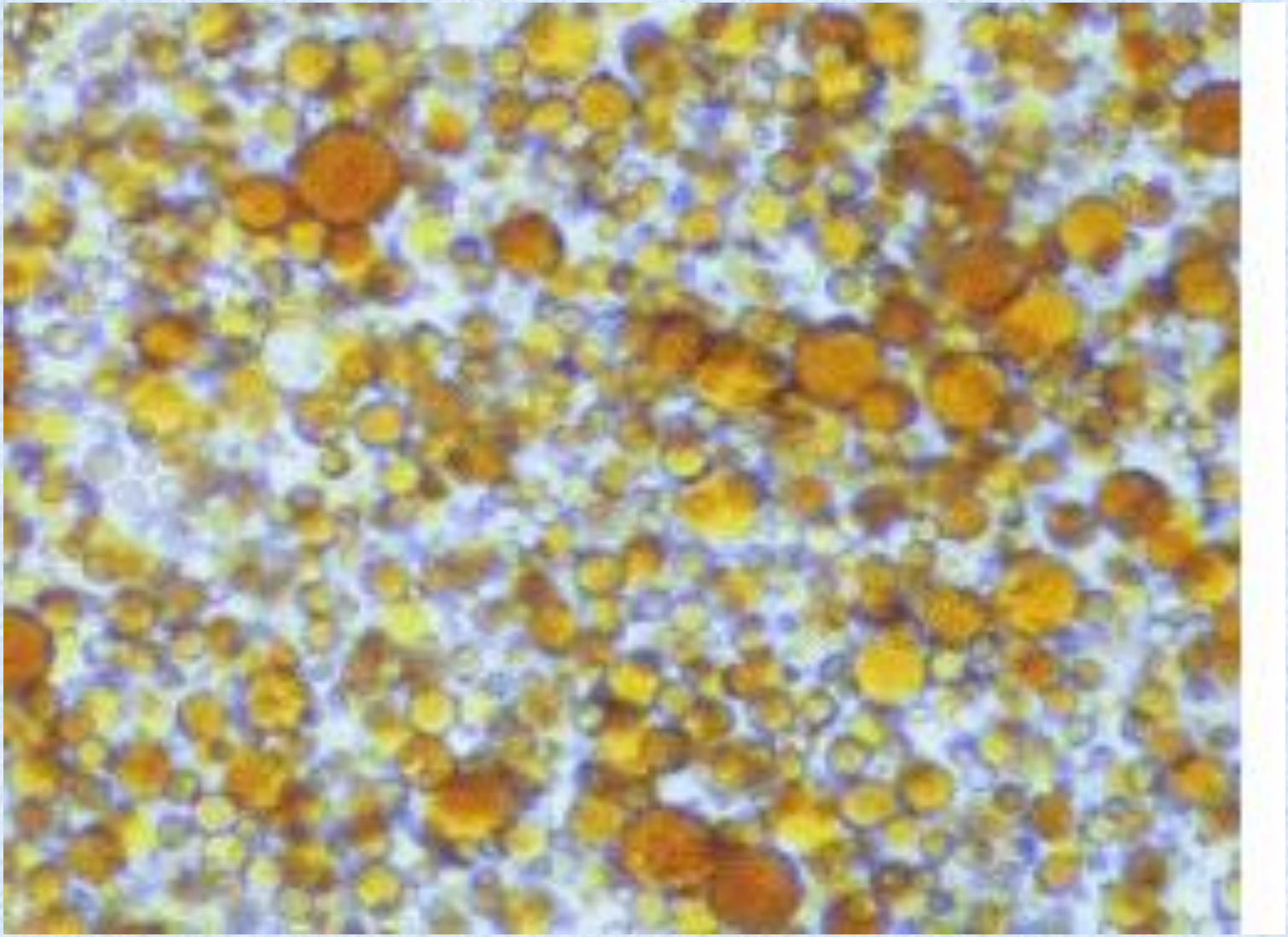
MANUFACTURING



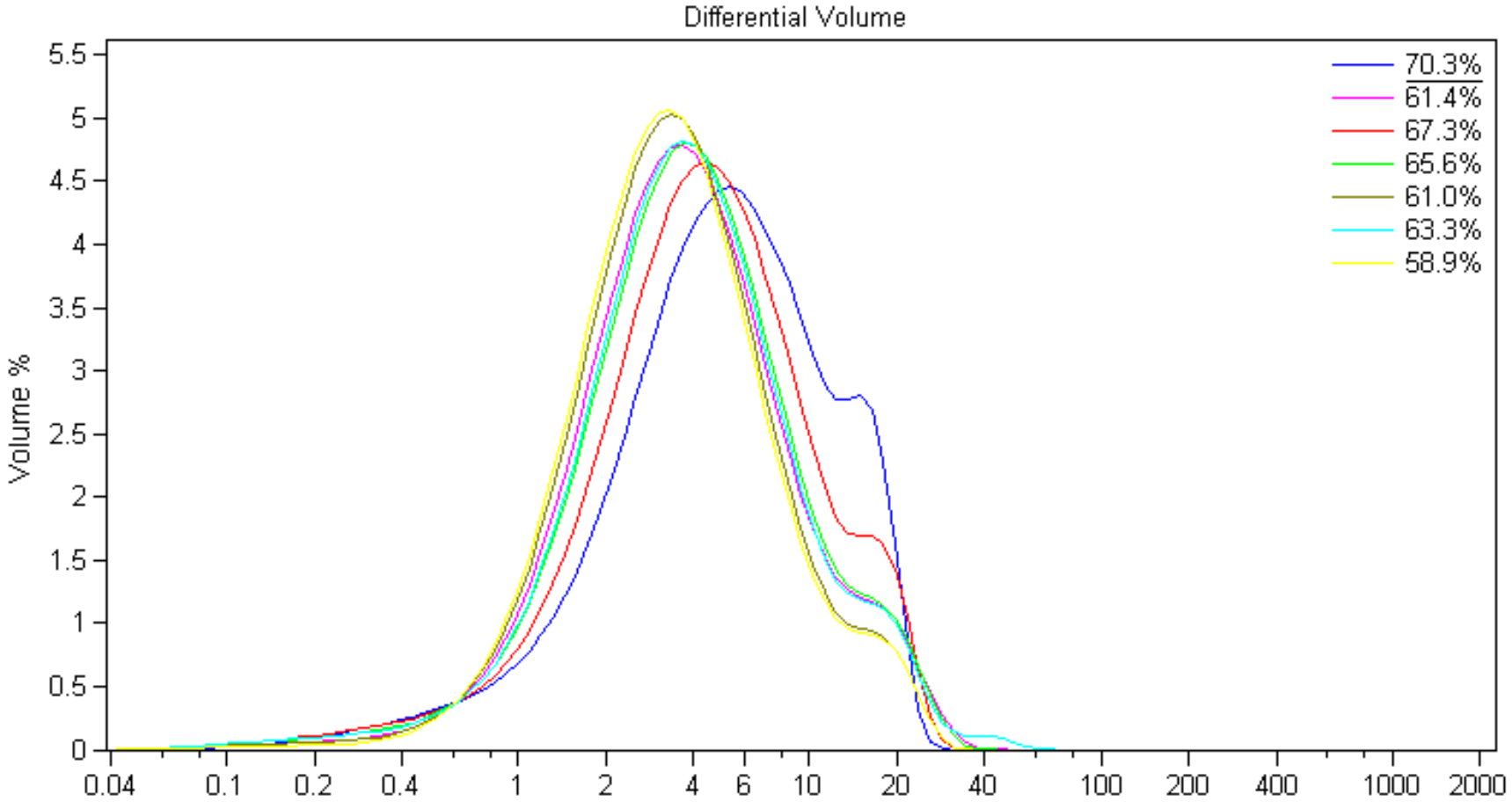


Simple
But We Must
Have
Balance

Asphalt Emulsion Droplet



Particle Size and Distribution



Size and Distribution Influenced by

Raw Materials

Mill Properties

Operating Conditions

Size and Distribution Influence

Physical properties of the emulsion

- Viscosity
- Storage stability

Larger size and broader distribution result in lower viscosities

Size and Distribution Influence

Emulsion Performance

Mixing **Spraying** **Coating**

Are all improved with smaller particle size

We Demand **Stability**

The emulsion must withstand being

Stored
Tested
Pumped

Transported
Pumped
Applied

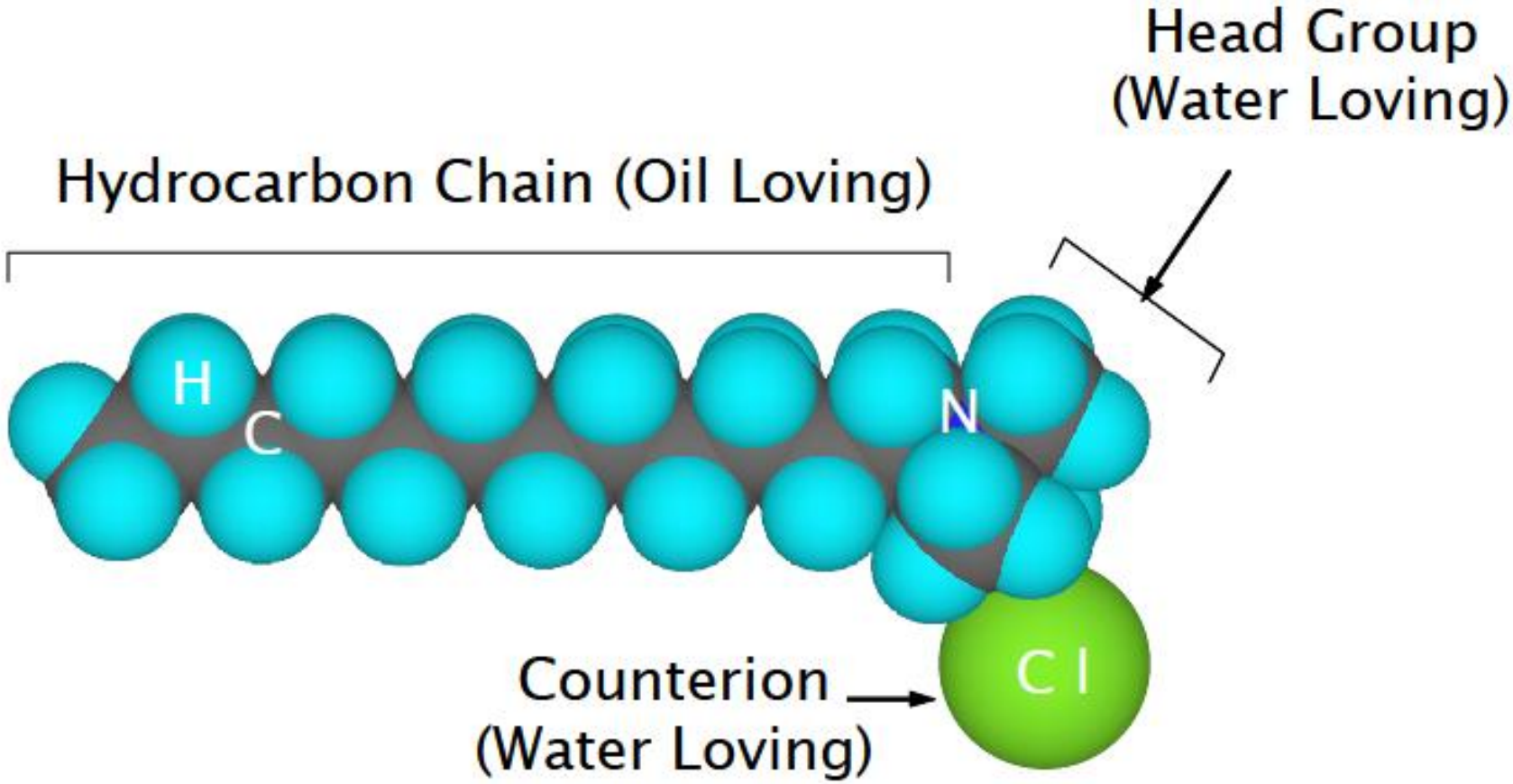
We Require **Instability**

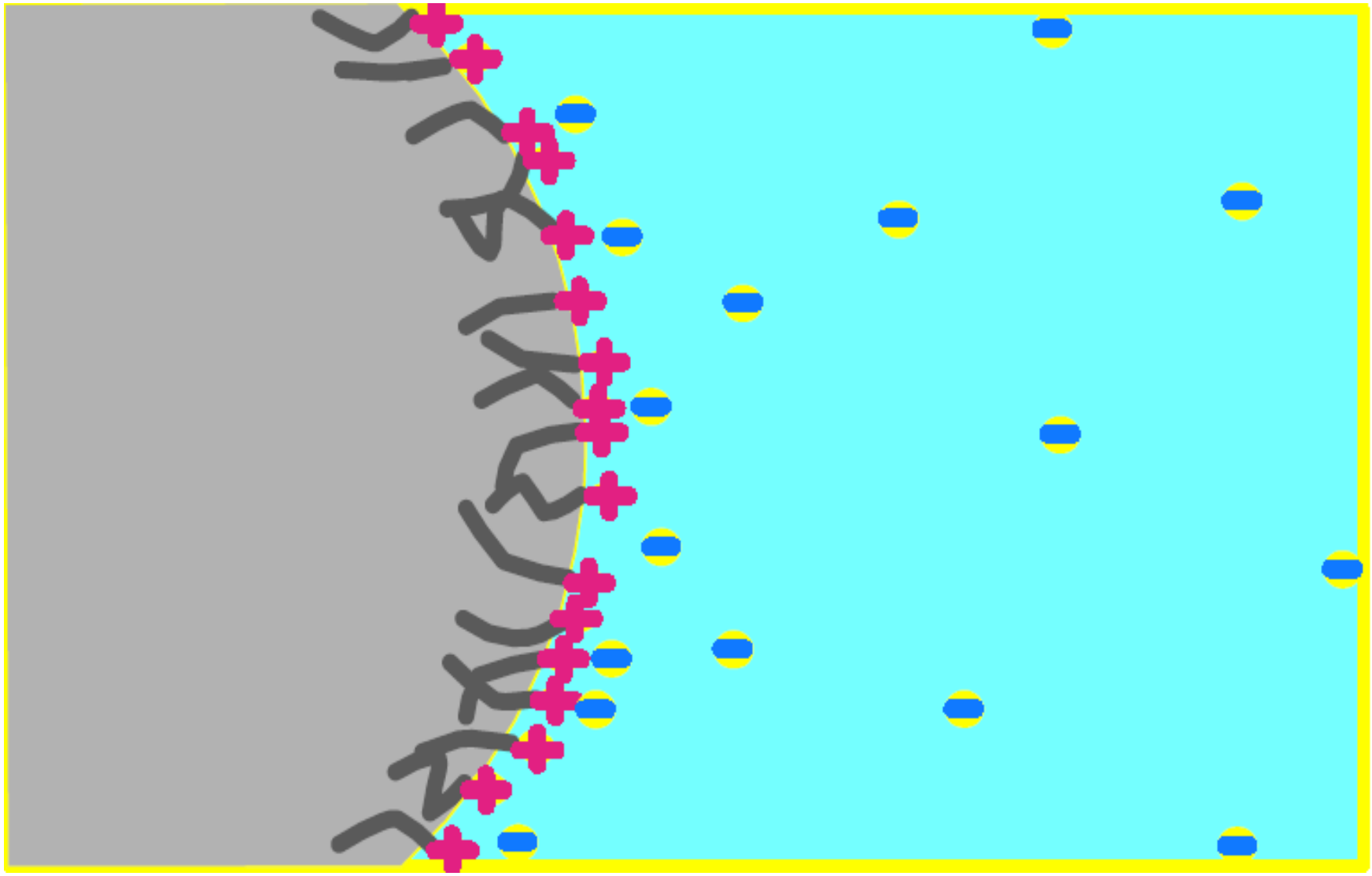
Asphalt needs to be in a relatively thin layer to function as a binder or glue holding aggregate particles together

Until an emulsion falls apart, the asphalt in it can not perform

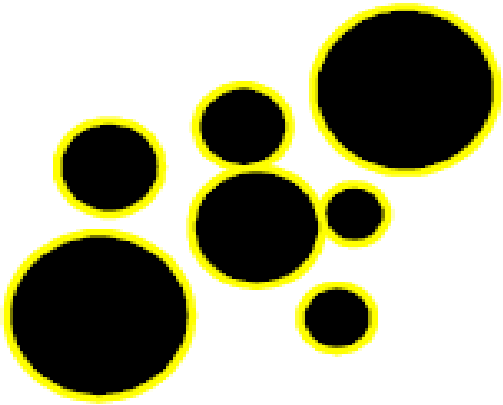
Compromise

The asphalt droplets in an emulsion have a small charge that repel other droplets on close approach. Once this force is overcome the asphalt separates from the water

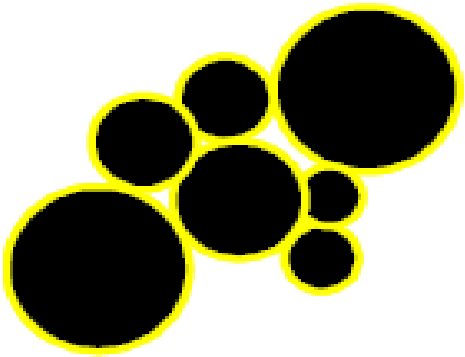

Head Group
(Water Loving)
Hydrocarbon Chain (Oil Loving)
H
C
N
Cl
Counterion
(Water Loving)



Flocculation to Coalescence

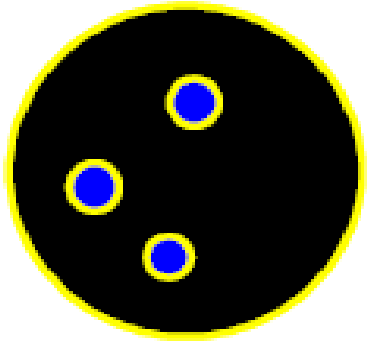


Emulsion charge on droplets prevents close approach.

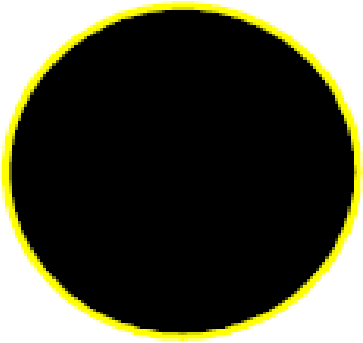


Flocculation: Close approach of droplets leads to adhesion between droplets. Water is squeezed out.

Flocculation to Coalescence



Coalescence: Water drains between droplets and surfactant film breaks down; droplets fuse, trapping some water.



Coalescence: Trapped water diffuses out.

Flocculation to Coalescence

Flocculation can be reversed or discouraged

- **Agitation**
- **Dilution (to a point)**
- **Emulsifier addition**

Coalescence is a more permanent condition

Flocculation to Coalescence

Gravity

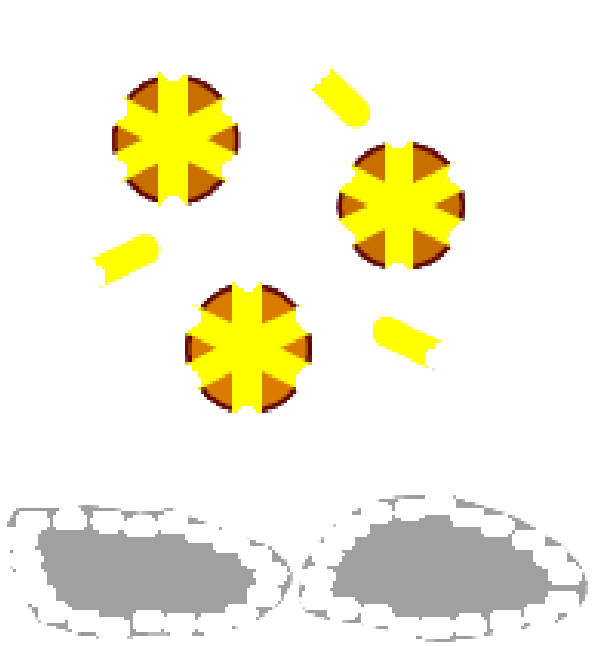
Evaporation

Shear

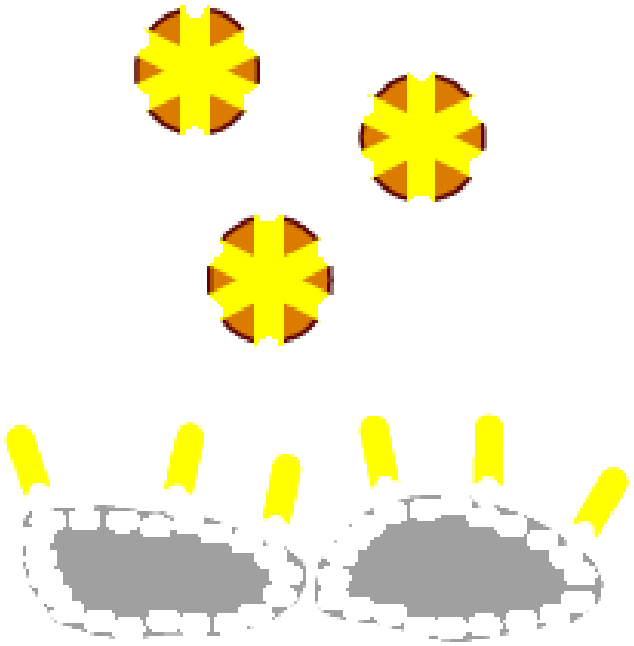
Temperature

Pressure

Flocculation to Coalescence

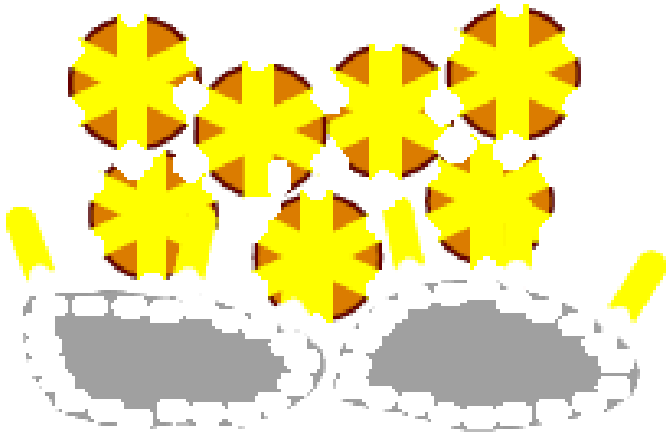


contact of emulsion with aggregate



adsorption of 'free' Emulsifier, pH rises

Flocculation to Coalescence



Rise in pH
leads to
flocculation

coagulation/spreading
over surface

Anionic emulsions typically rely on evaporative or mechanical forces to reach coalescence

Emulsion Testing

Handling

Classification

Residue

Handling

Residue Content

Viscosity

Storage stability

Sieve

Classification

Demulsibility

Cement Mixing

Coating

Residue

Penetration

Ductility

Elastic Recovery

Softening Point

Emulsion Testing

Are you sure you want it in spec

There is sometimes a difference between an emulsion being in spec and performing as expected

Double Chip Seal

Middle of August in Arkansas

CRS-2P

Granite aggregate

Demulsibility of 50

What is the likely result?

Texas Chip Seal

TX Grade 2 Aggregate

Shot Rate .60 gal/yd2

CRS-2P

Viscosity @125 SSF

What is the likely result?

Fog Seal

Mississippi Summer

Over a fresh Chip Seal

Product is CSS-1

In spec but….

What is the likely result?

Late Season Chip Seal

Northern Climate

CRS-2

Penetration of 100

In spec maybe but…

What is the likely result?

Work on understanding properties and the effect on the project you have planned. Work with your industry partners to examine the requirements for the project.

BE FLEXIBLE

Emulsions used in preservation techniques are a balance of the issues we have discussed and many that we have not **MUCH more information** is available on these topics. Great strides are being made in all areas of asphalt emulsion usage.