

# Aggregate

“Aggregate plays a critical role in the design and construction of the nation’s infrastructure. Aggregate is the largest single cost item used in pavement construction materials ... Therefore, the properties of aggregate and aggregate-binder mixtures are very important to the life of the system”

Base

Portland Cement

Asphalt



# Properties of Aggregate

A property is a quality that is indicative of a specific characteristic of a material



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## Physical Properties

- Particle Shape
- Maximum Size
- Surface Texture
- Pore Structure
- Absorption
- Thermal Volume Change
- Permeability
- Specific Gravity
- Particle Grading
- Integrity During Heating
- Porosity
- Thermal Conductivity
- Voids in Aggregate Mixture
- Electrical Conductivity
- Reflection
- Glare
- Color
- Volume Change
- Resistance to Wetting
- Resistance to Freezing-Thawing
- Deleterious Substances



# Properties of Aggregate

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## Chemical Properties

- Solubility
- Slaking
- Resistance to Attack by Chemicals
- Coatings
- Oxidation Reactivity
- Base Exchange
- Chemical Compound Reactivity
- Chloride Content
- Surface Charge
- Hydration Reactivity
- Organic Material Reactivity



# Properties of Aggregate

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## Mechanical Properties

- Particle Strength
- Particle Shape of Abraded Fragments
- Wear Resistance
- Resistance to Degradation
- Particle Stiffness
- Mass Stability
- Resilient Modulus



# Deleterious Substances



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  - Aggregate particles, such as chert, which exhibit disruptive expansion



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  - Aggregate particles, such as chert, which exhibit disruptive expansion
  - Aggregate particles which react chemically



# ODOT Supplement Specification 1029

- Identifies the following materials as being deleterious substances

Chert	Expansive & Reactive
Shale	Coating, Organic, Soft, & Expansive
Limonitic Concretions	Soft, Expansive, & Reactive
Clay Lumps	Coating & Soft
Coal & Lignite	Organic & Soft



# Coal & Lignite



Coal is a black organic rock consisting of greater than 50% carbon; it forms from the buried and altered remains of plant material

Lignite is low-rank coal that consists of 50% carbon

## Key Features

- Black in color
- Moderately soft and brittle
- May appear laminated



# Clay Lumps



Clay lumps are a form of unconsolidated sediment which retains plastic properties and is formed from microscopic and submicroscopic particles

## Key Features

- No visible grains
- Behaves plastically when wet
- Leaves a powdery streak





# Limonitic Concretions



Limonitic Concretions are compact masses of minerals or clay surrounded in a hydrous iron oxide shell

## Key Features

- Peanut-butter M&M
- Smooth, hard shell
- Soft, powdery clay center

**\*\*Note:** It must contain a soft clay center to be considered a limonitic concretion.

So crack them open!





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# Chert



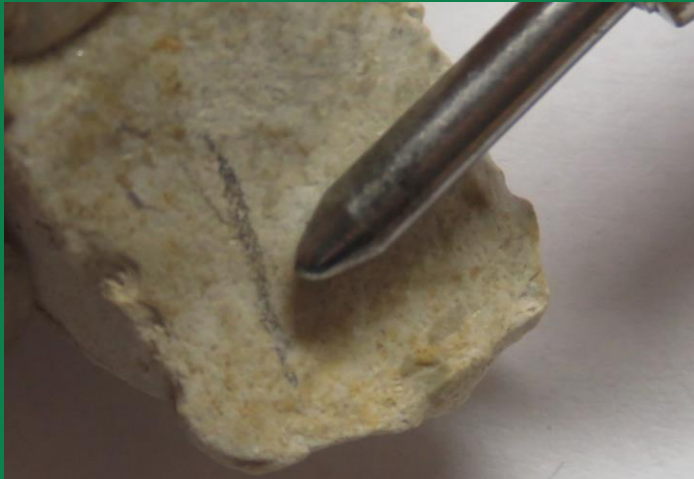
Chert is a very fine-grained siliceous rock composed of crypto-crystalline quarts, chalcedony, or opal – or any combination of the three

## Key Features

- Very hard, hardness near 7
- Conchoidal fracture
- Waxy luster in dense varieties
- Chalky surface in porous varieties



# Chert



## Hardness

- A steel knife blade or nail will not scratch chert and will usually leave some metal on the surface of the aggregate
- Chert will scratch a piece of glass



## Conchoidal Fracture

- When broken, dense chert will display smoothly curving, clamshell-shaped surfaces



# Shale



Shale is very fine-grained sedimentary rock that breaks into thin sheets

## Key Features

- Relatively soft
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- Various colors: gray, black, green, red





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# Shale



## Hardness

- When pressure is placed on the particle and pulled across a “streak-plate” a powder is left behind



## Fissile appearance

- The appearance of layers



# Shale A vs. Shale B



## Shale A:

703.02, 703.04, 703.11

50% or more of the particle visually is comprised of shale

## Shale B:

703.05, 703.12

Consists of 100% shale, has shale adhering to it, or contains stringers within it



# Shale B



“Has shale adhering to it”

Particles that are stained on the surface due to being in contact with a shale seam or a stringer shale not be counted as deleterious shale if there is no actual shale present





# Shale B



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“Discernable thickness”



# Shale B



“Contains stringers within it”

Stringers do not have a defined thickness, but should be a flat layer within the aggregate that can be traced across multiple sides of the particle



# Shale B



“Contains stringers within it”

Stringers do not have a defined thickness, but should be a flat layer within the aggregate that can be traced across multiple sides of the particle

Wetting the particle helps



# Questions

