Pavement Recycling

Workshop & Lectures on Pavement Engineering, Maintenance and Management

References

- HMA for graduate students manual

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Advantages

- Reduced Cost of Construction
- Conservation of Aggregate and Asphalt Binders
- Preservation of Existing Pavement Geometrics
- Preservation of Environment
- Conservation of Energy
- Less User Delay

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Recycling is One of the Various Rehabilitation Alternatives

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Recycling Methods

- Hot Mix Recycling
- Hot In-Place Recycling
- Cold In-Place Recycling
- Full Depth Reclamation

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Hot Mix Recycling: Process

- RAP is combined with new aggregate and asphalt binder or recycling agent in a hot mix plant. Mix is transported to paving site, placed, and compacted.

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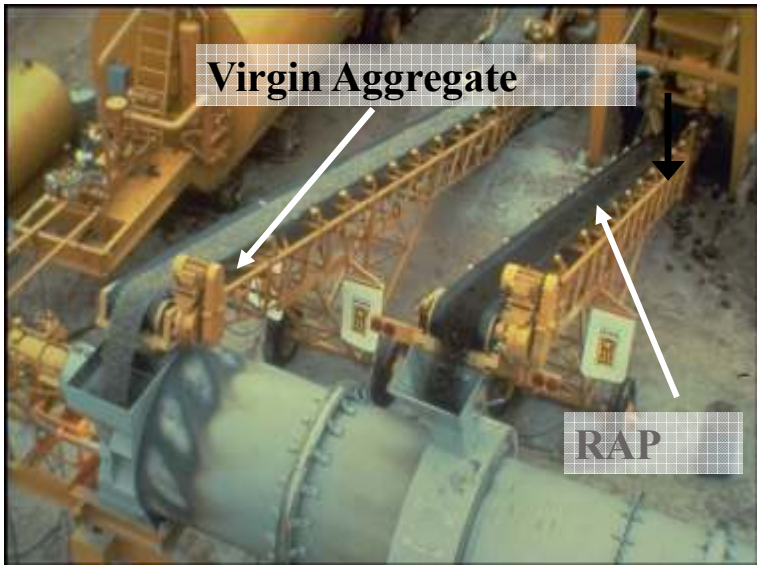

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Hot In-Place Recycling: Process

- Existing HMA surface is heated, scarified to a depth from 20 to 40 mm, scarified material combined with Aggregate and/or Asphalt Binder and/or recycling agent and compacted. New overlay may or may not be provided.

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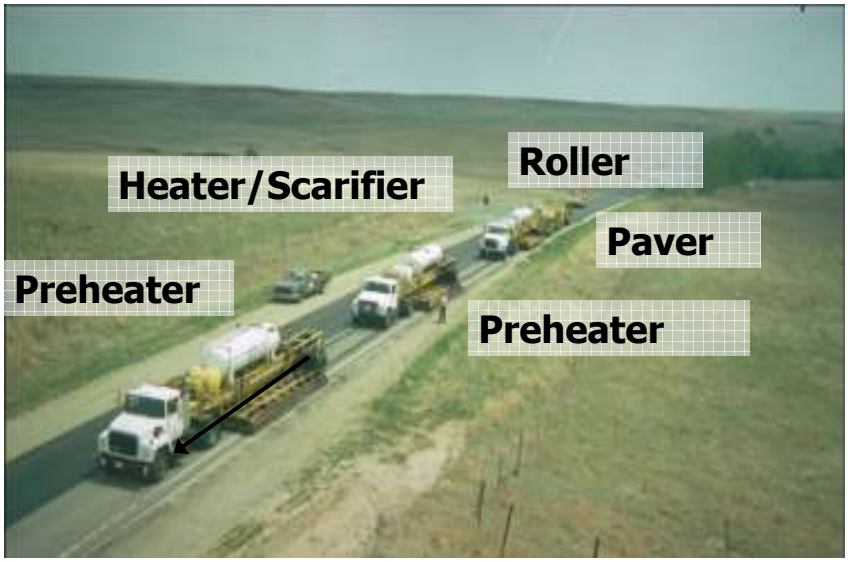
Heater/Scarifier
Roller
Paver
Preheater
Preheater

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Hot In-Place Recycling: Repaving
New Mix
Repaving Machine
Heater

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Cold In-Place Recycling: Process

- Existing asphalt pavement milled (75 to 100 mm Depth), RAP reduced if needed, mixed with recycling agent, placed, and compacted.

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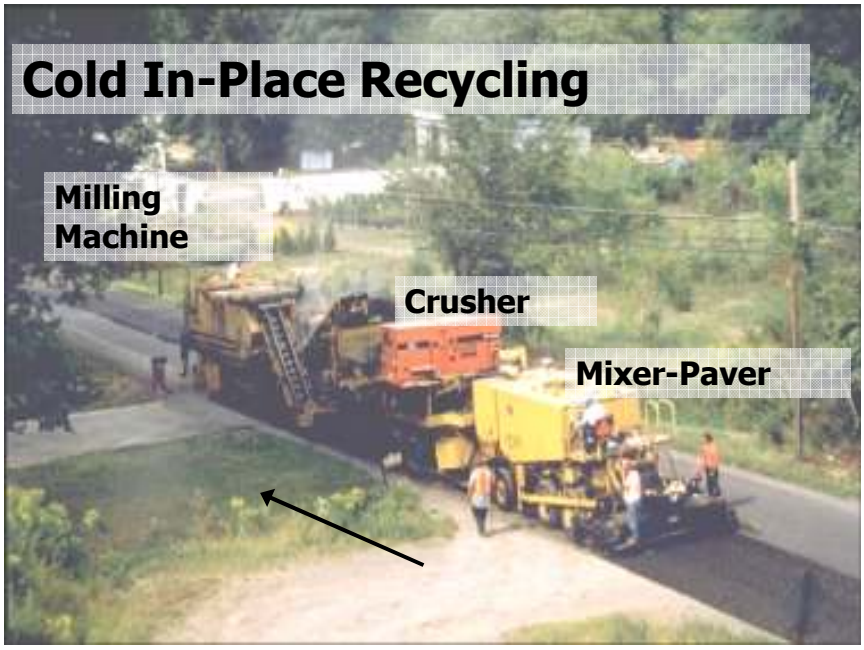

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Full Depth Reclamation: Process

- All HMA layers and predetermined thickness of underlying material pulverized, stabilized with additives, shaped, and compacted. A surface course is applied.

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HOT MIX RECYCLING

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Removal of Existing Pavement

- Ripping and Crushing
- Cold Milling

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Pavement Ripping with Dozer

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Dozer with Rear Mounted Ripper Tooth

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Full Lane Cold Milling Machine

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Hot-Mix Recycling

- Batch
- Drum

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HOT MIX RECYCLING WITH A BATCH PLANT

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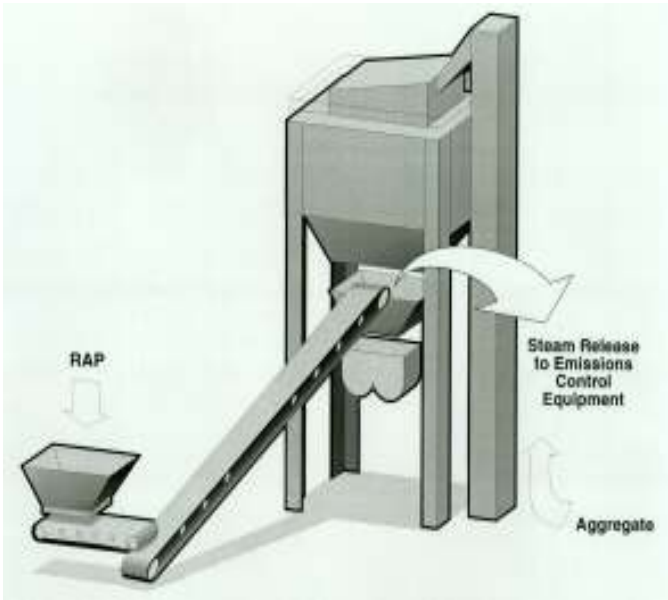
Weigh Bucket Recycling



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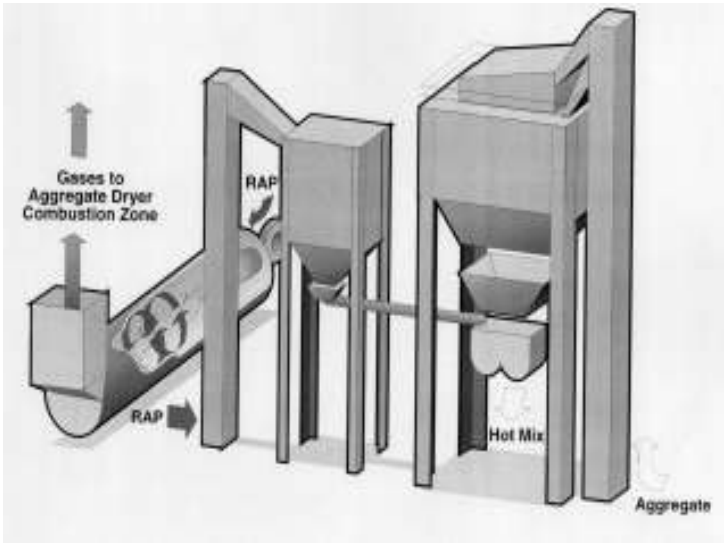
RAP Dryer System



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HOT MIX RECYCLING WITH A DRUM MIXER PLANT

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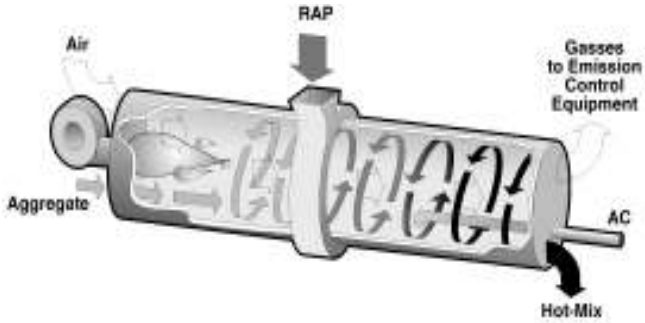
Parallel-Flow Drum-Mixer



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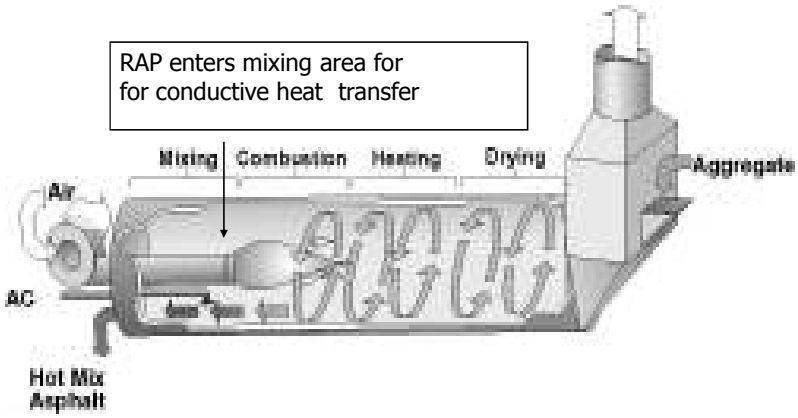
Counter-Flow Drum-Mixer



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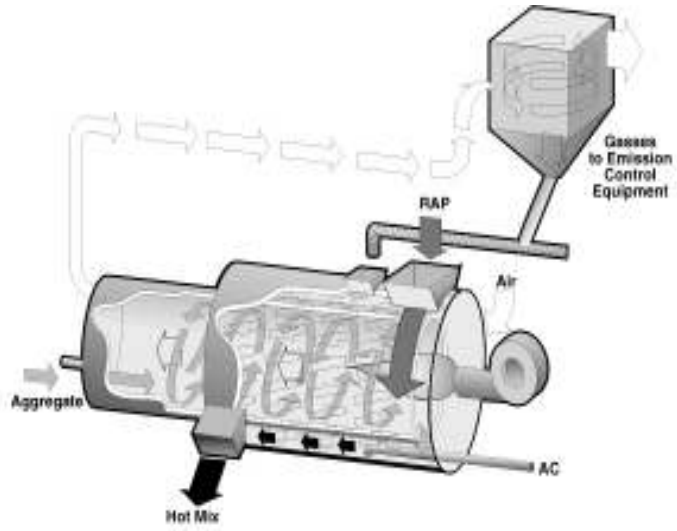

UNITIZED COUNTER-FLOW DRYER
CONTINUOUS-MIXER

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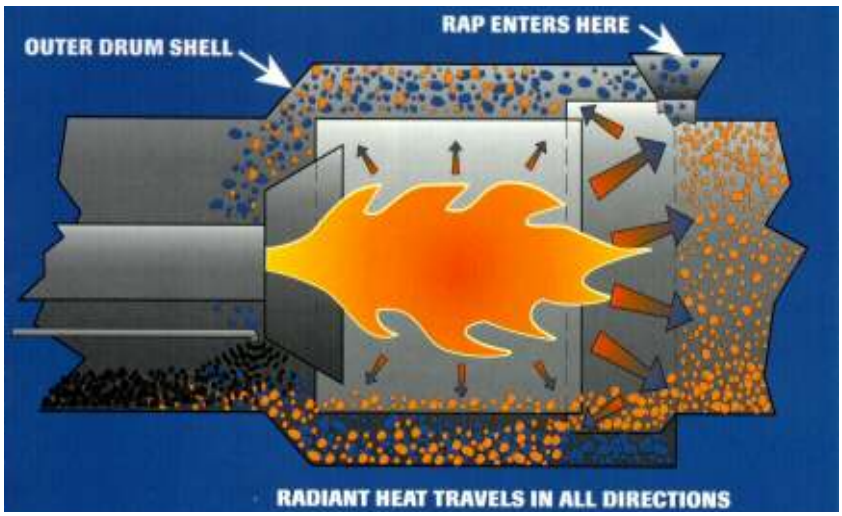
Schematic of a Triple Drum Plant



Red Arrows Indicate Direction of Travel of Radiant Heat

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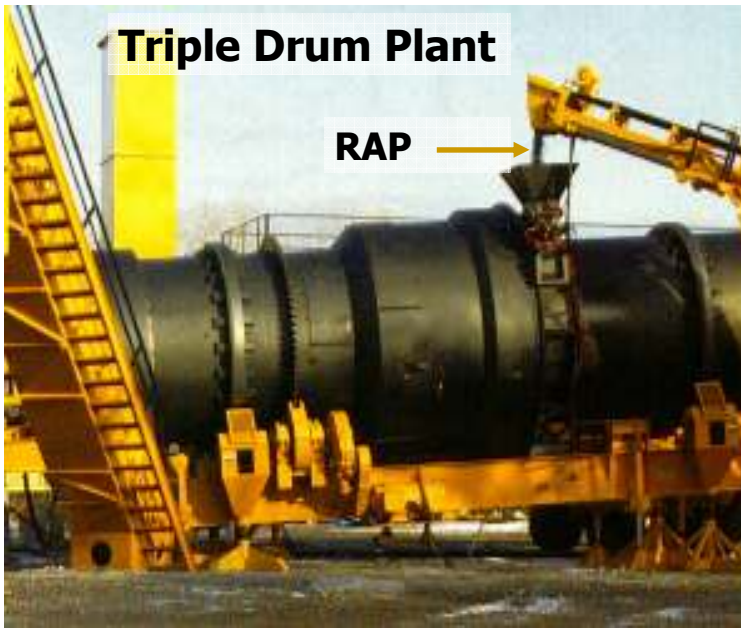

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Amount of RAP in Drum Plant Recycling

- Factors
  - Moisture Content of RAP
  - Temperature of Superheated Aggregate
  - Temperature of RAP
  - Temperature of Recycled Mix
- Amount of RAP
  - Maximum: About 70 %
  - Practical: About 30 % - 50 %

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HOT IN-PLACE RECYCLING

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Surface recycling

- On site, Hot In-Place method that rehabilitates deteriorated HMA pavements and thereby minimizes use of new materials
- Depth recycled: 25 - 50 mm (one to two inches)

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4 Basic Steps

- Softening pavement with heat
- Scarification or mechanical removal of softened material
- Mixing with recycling agent, new aggregate, new binder, or new mix
- Laydown and paving

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A definition

- Recycling agent
  - An aromatic oil – generally a specialty product.
  - A soft asphalt binder (a PG 52, or an AC 5)

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Reasons for surface recycling

- Pavement geometry is preserved
- Corrects surface distresses not caused by structural inadequacy
- Can modify existing surface mix
- Can improve surface frictional resistance
- Relatively cheap
- Needs less traffic control

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Early Propane Heater and Scarifier

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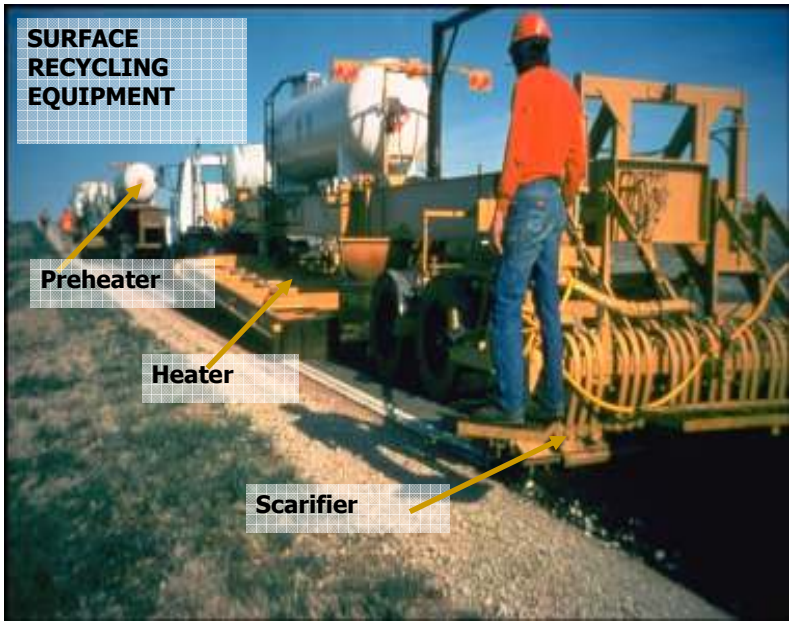
SURFACE RECYCLING EQUIPMENT



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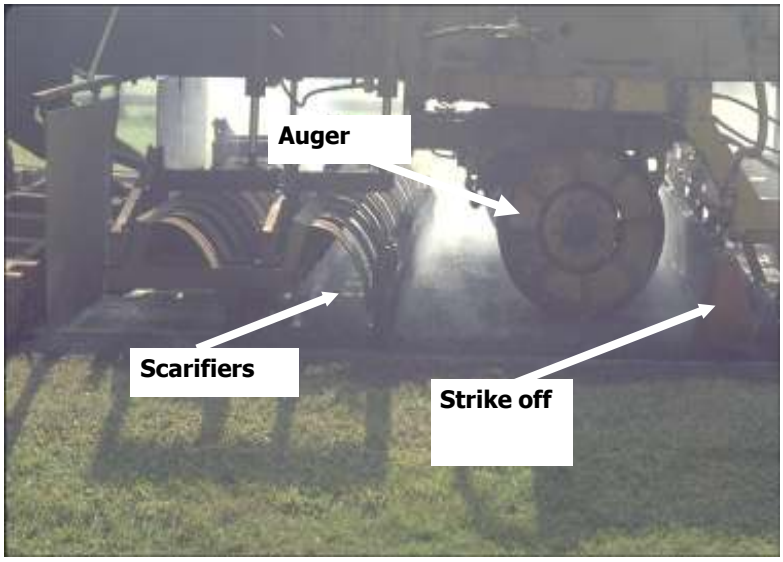

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Repaving Machine
New Mix
Heater

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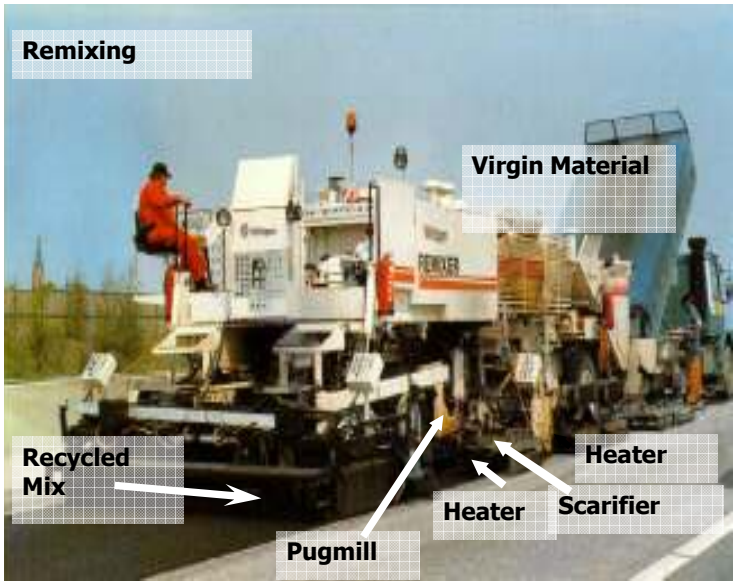
Remixing
Virgin Material
Recycled Mix
Heater
Heater
Scarifier
Pugmill

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COLD IN-PLACE RECYCLING

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COLD IN-PLACE RECYCLING

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Cold In-Place Recycling

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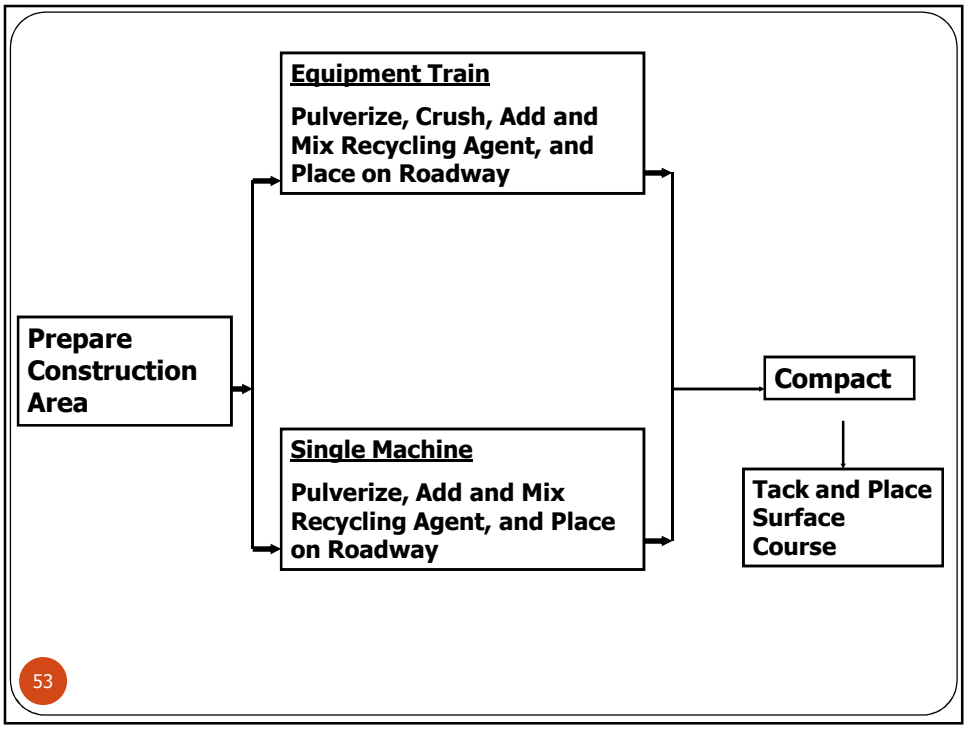
Equipment Train
Pulverize, Crush, Add and Mix Recycling Agent, and Place on Roadway
Prepare Construction Area
Compact
Single Machine
Pulverize, Add and Mix Recycling Agent, and Place on Roadway
Tack and Place Surface Course
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SINGLE MACHINE
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Single Machine

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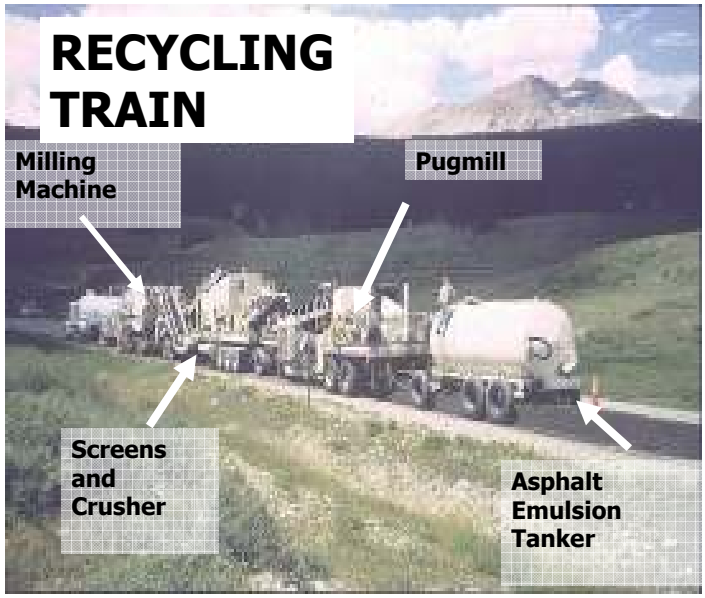
RECYCLING TRAIN



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Recycled Mix

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Mixer
Emulsion Nurse Truck
Windrow of Recycled Mix

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Compaction with Pneumatic Tire Roller

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Compaction

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Recycled Mix Design

- Basic design steps
  - Field samples
  - Laboratory analysis
  - Field adjustments

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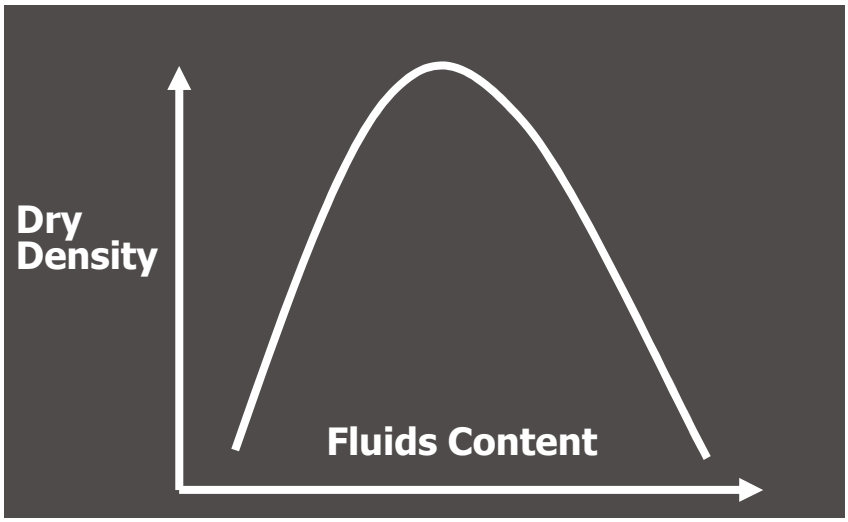
Typical Design Criteria



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Stabilizing Additives

- Cementing agents
  - Portland Cement
  - Lime
  - Lime/Fly ash
- Asphalt binder emulsions
  - Slow setting
  - High float
  - Polymer modified

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FULL-DEPTH RECLAMATION

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Single Machine

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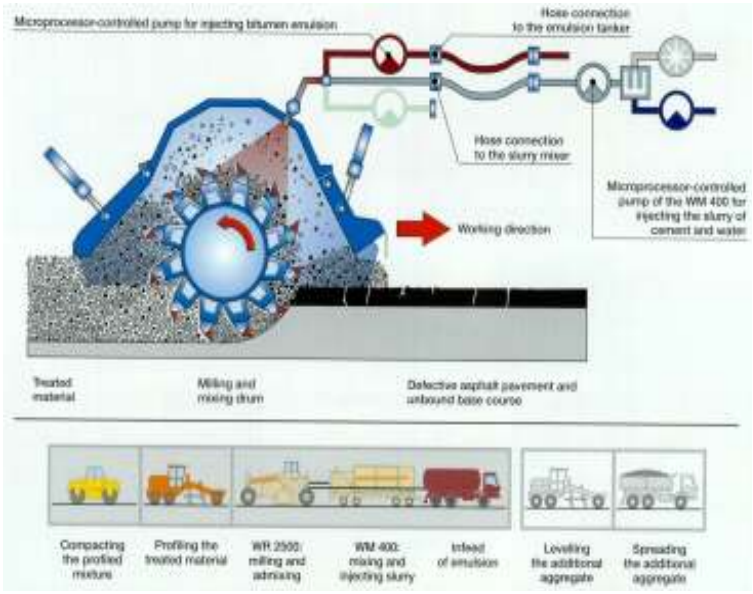
Schematic of single machine



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