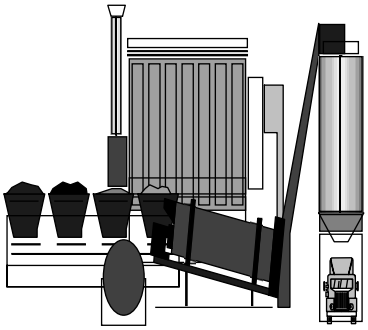
MARTCP

Training Qualification Program

Hot Mix Asphalt

Plant Technician Level I



Modern HMA Production Facilities

1

Modern HMA Facilities

Two Basic Types of Plant Configurations

- **Batch**
- **Continuous (Drum-Mixer)**

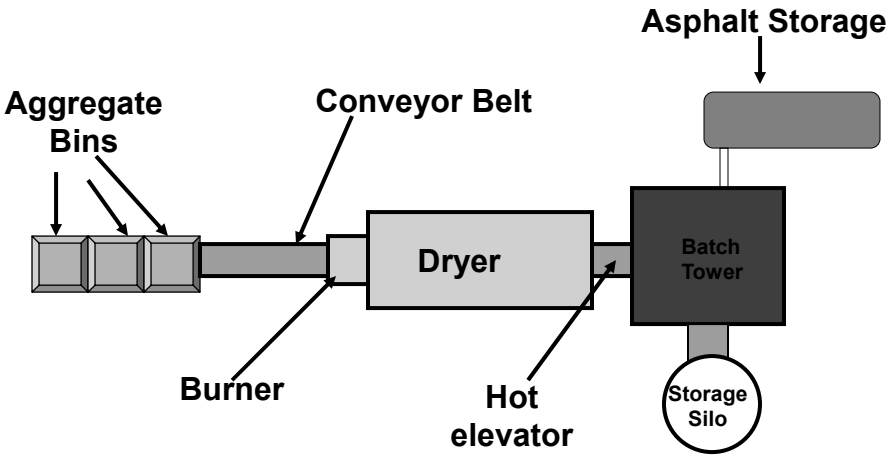
2

Types of Asphalt Plants

Batch **Drum Mixer**

3

Batch plant (typical layout)



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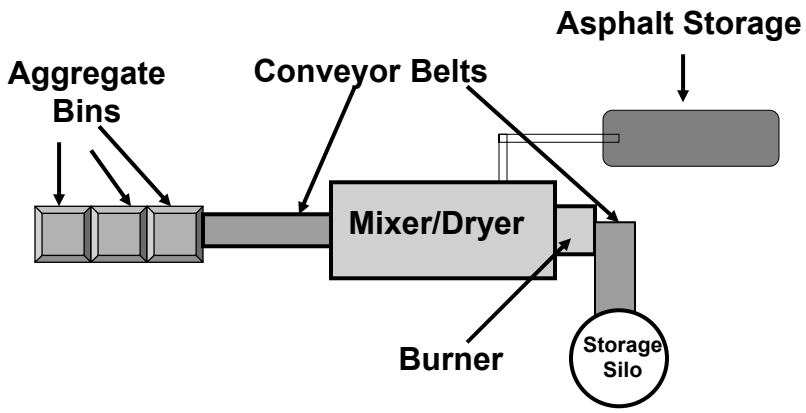
Drum Mixer Plant (typical layout)



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Basic Purpose of Asphalt Plants

- ✓ Produce a quality hot asphalt mixture that
- ✓ Contains the desired proportions of asphalt and aggregate and
- ✓ Meets all specifications.

6

Objectives

- Describe how both plants have similar requirements and common operations
- Differentiate between batch and drum-mix facilities
- Describe how aggregate gradation and asphalt content are controlled in both plant types

7

Requirements for All Asphalt Plants

Scales for commerce regulated in most states by :
Department of Agriculture
Bureau of Weights and Measures

Air Quality Permit & Storm Water Permit
regulated by:
Department of Environment

8

Common Plant Operations

- Cold aggregate storage and feeding
- Dust control and collection
- Mix storage
- Weighing and handling

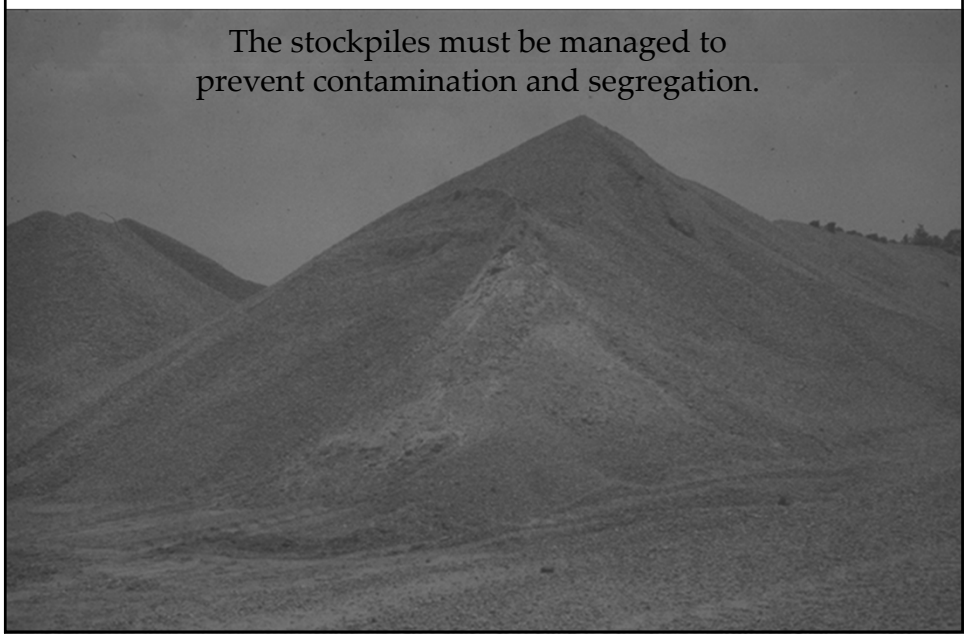
9

Common Plant Operations

- Cold Aggregate Storage and Feeding

10

Aggregate Stockpile



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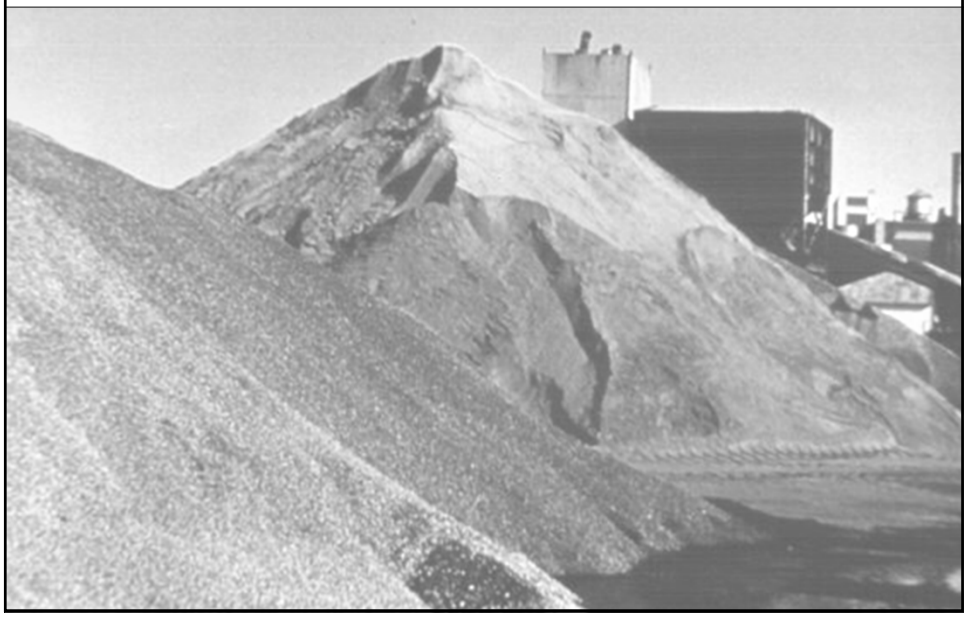
Stockpiling Operations



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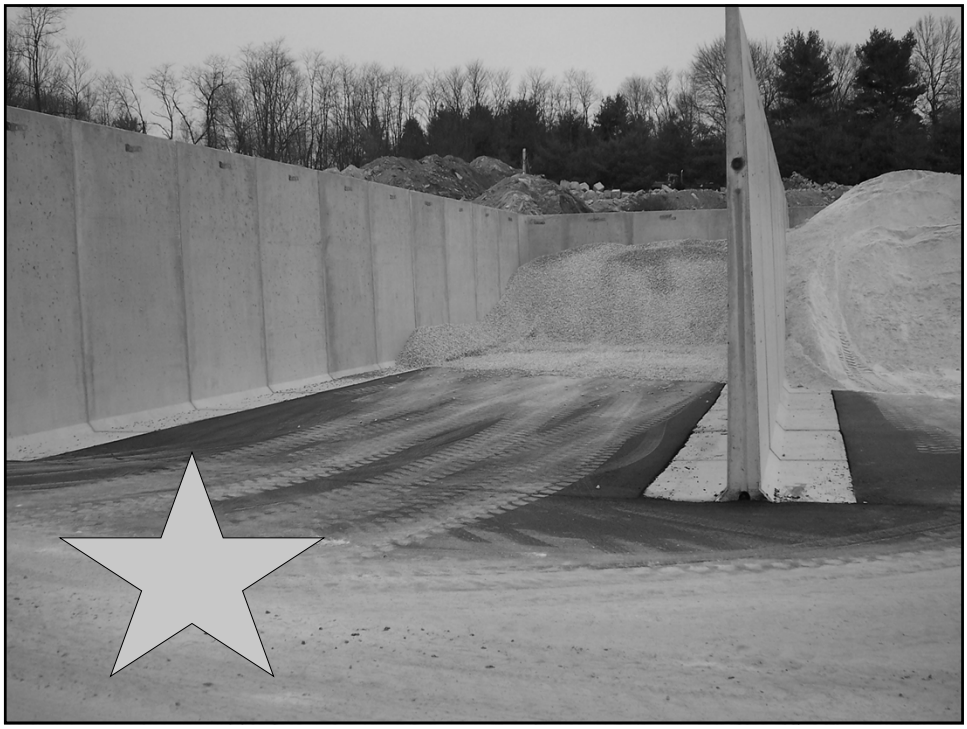

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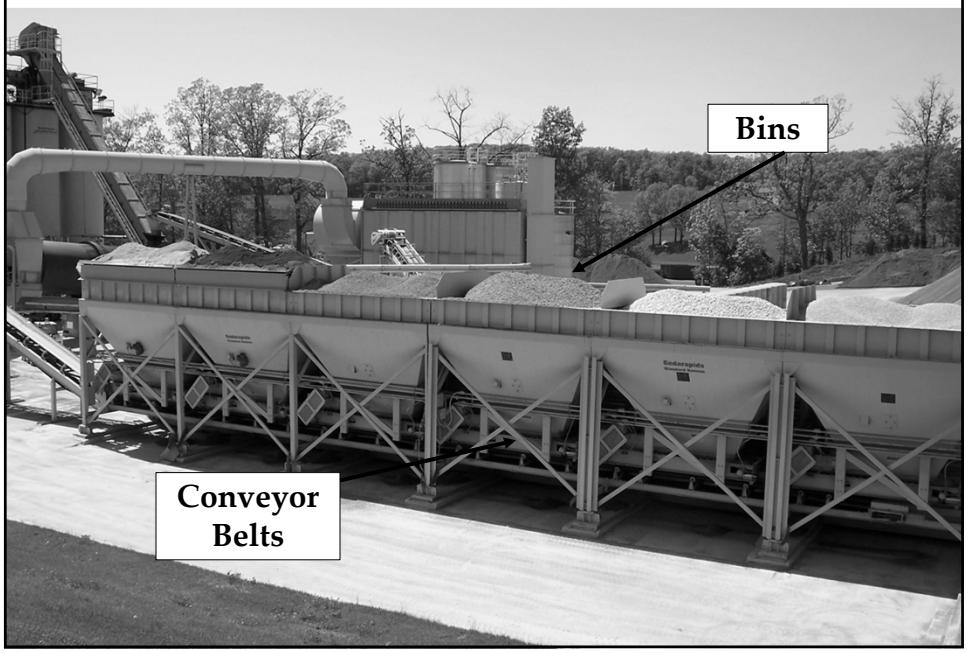
Aggregate Cold Feed



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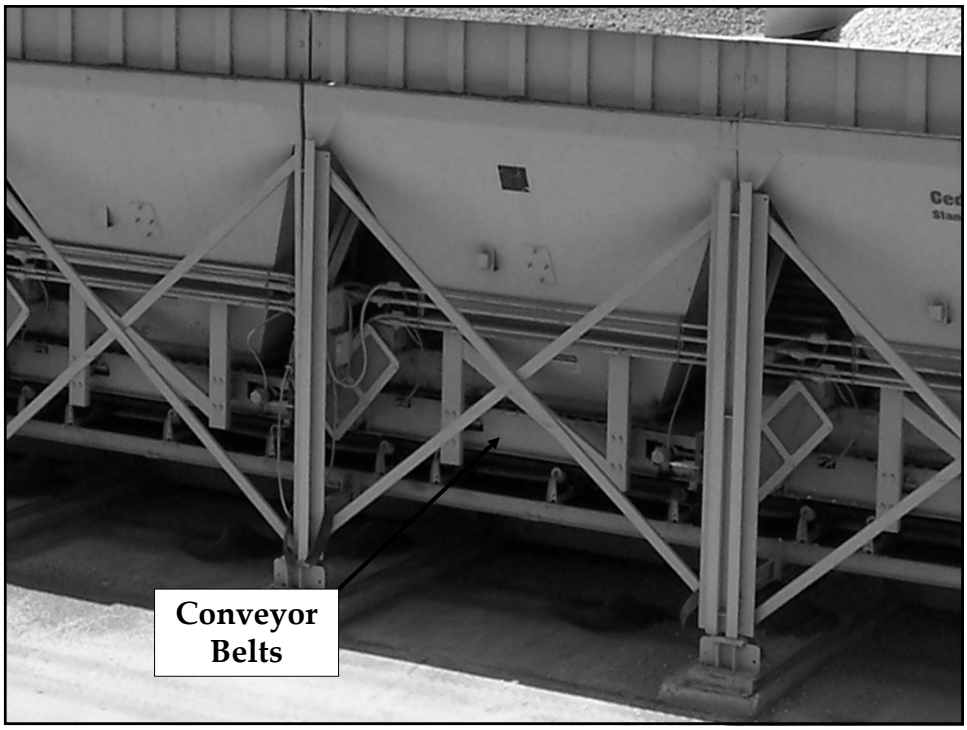

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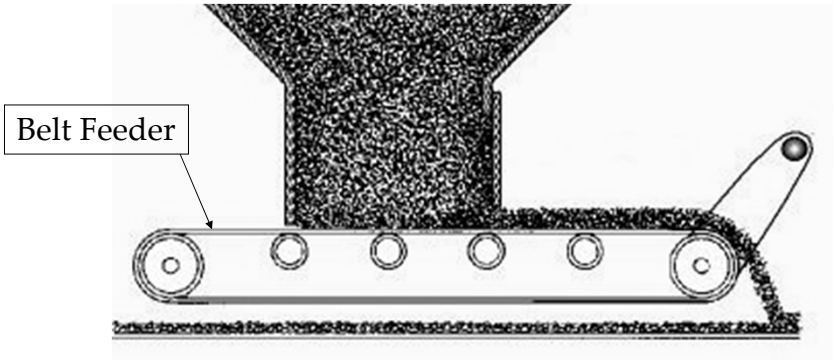
Belt Feeder



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Common Plant Operations

- Cold aggregate storage and feeding
- Dust control and collection
- Mix storage
- Weighing and handling

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Asphalt Mixing Plants Create Dust

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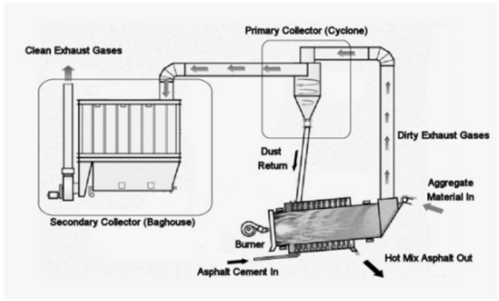
Centrifugal Dust Collector



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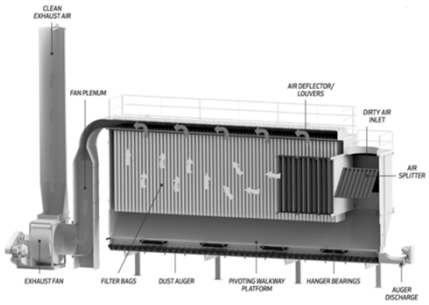
Baghouse Dust Collector



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Baghouse Video

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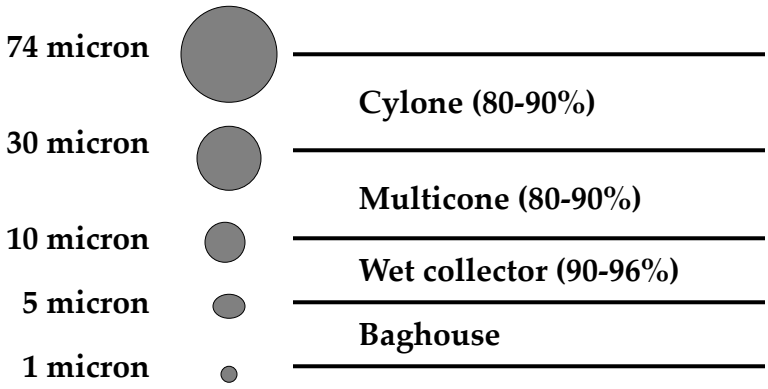
Collector Efficiency



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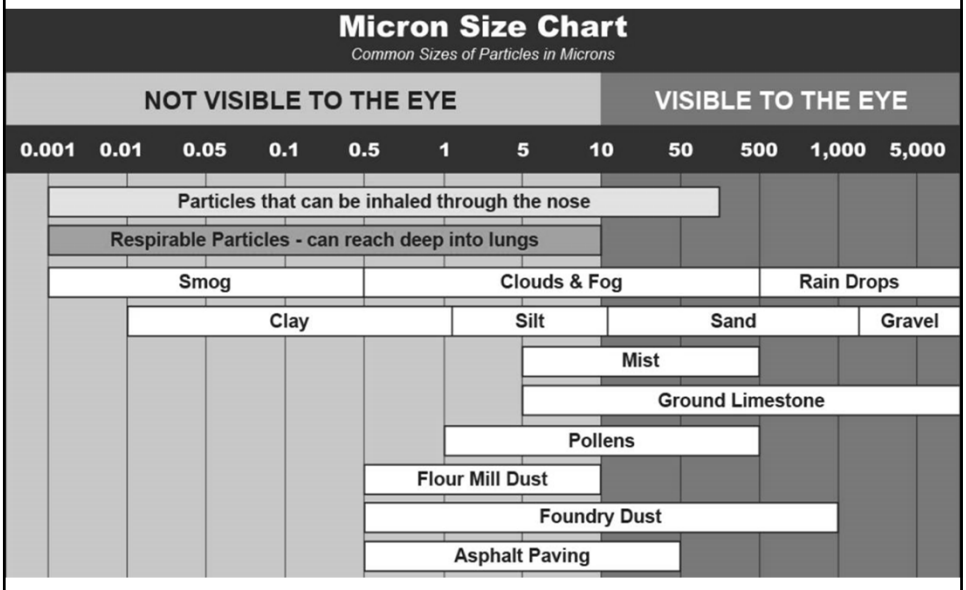

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Common Plant Operations

- Cold aggregate storage and feeding
- Dust control and collection
- Mix storage
- Weighing and handling

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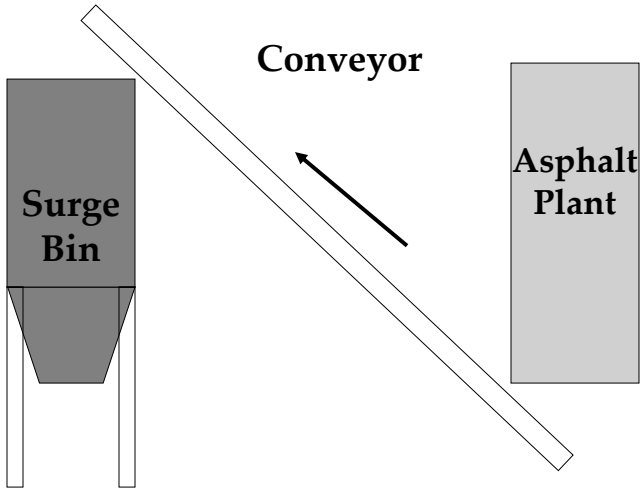
Storage Structure - Typical Layout



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Common Plant Operations

- Cold aggregate storage and feeding
- Dust control and collection
- Mix storage
- Weighing and handling

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! Plants are Computer Controlled

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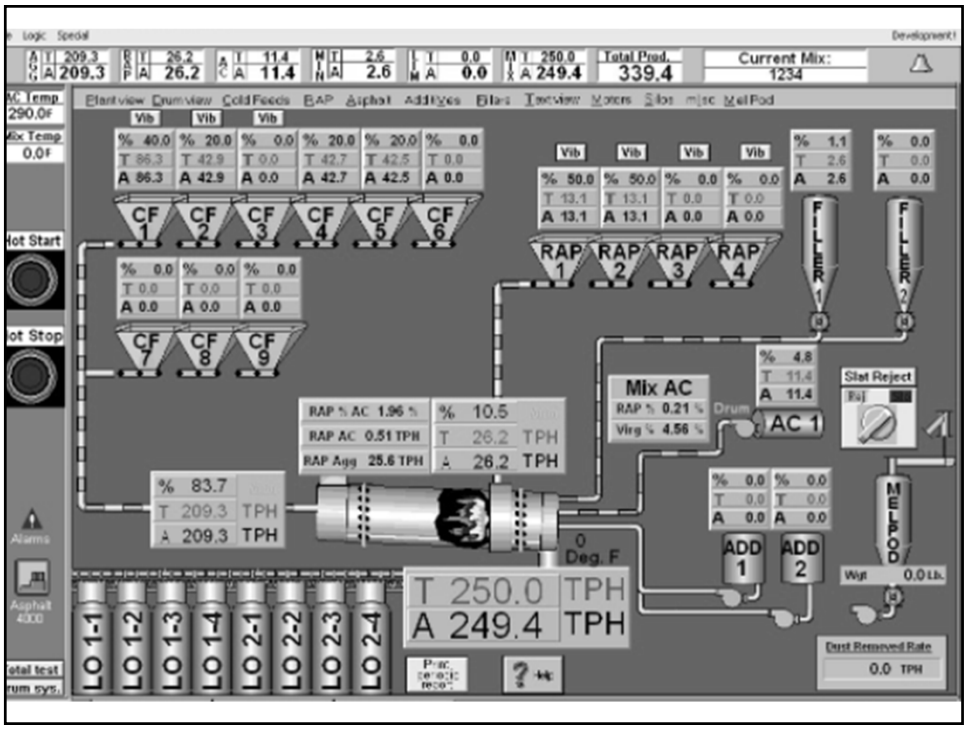

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Truck Being Loaded Directly from a Batch Plant

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Truck Being Loaded from a Surge Silo

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Truck Loading from a Surge Bin

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Batch Plant Video

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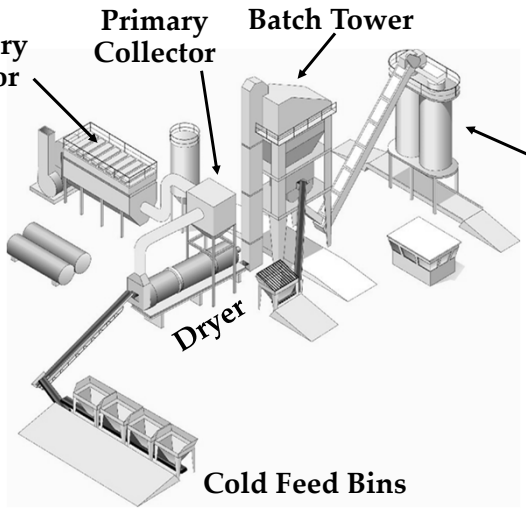
Batch Plant Elements



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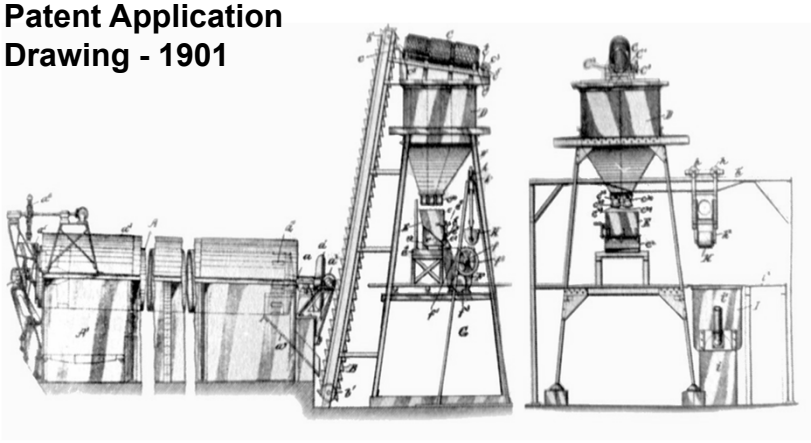
Warren Brothers Batch Process

Patent Application Drawing - 1901



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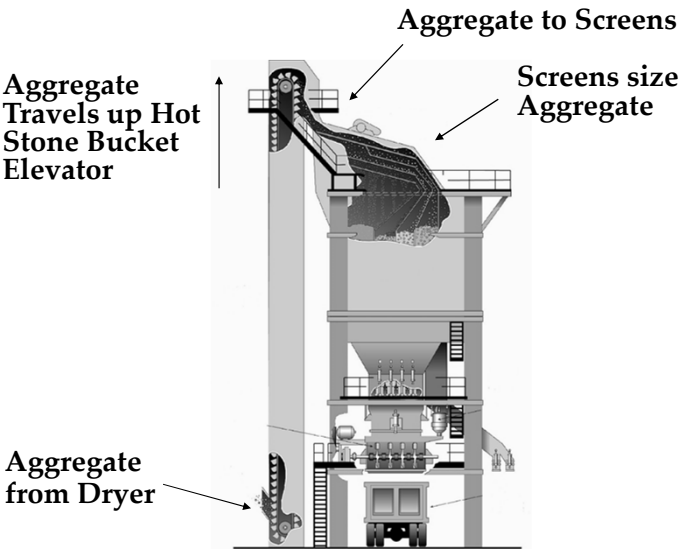
Batch Tower



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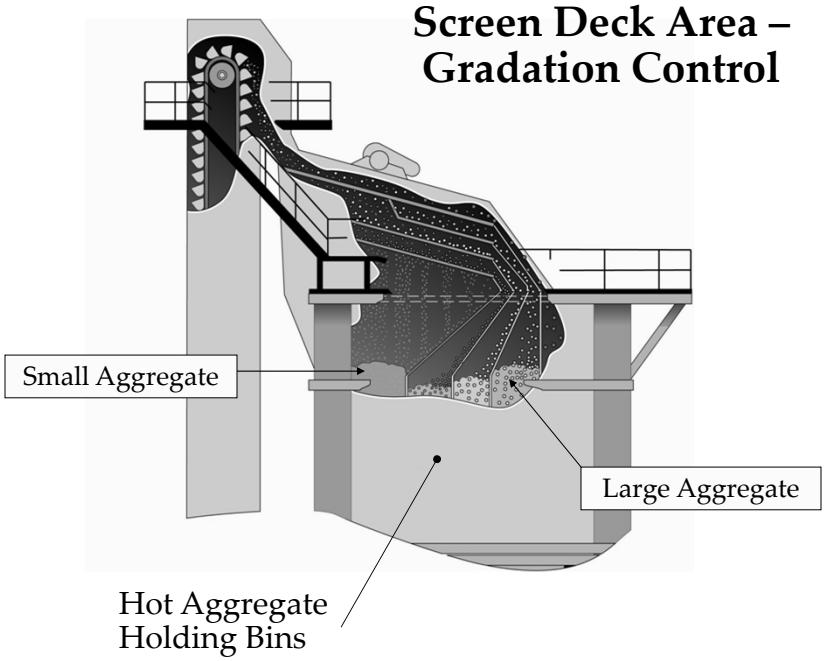
Screen Deck Area – Gradation Control



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Screen Deck

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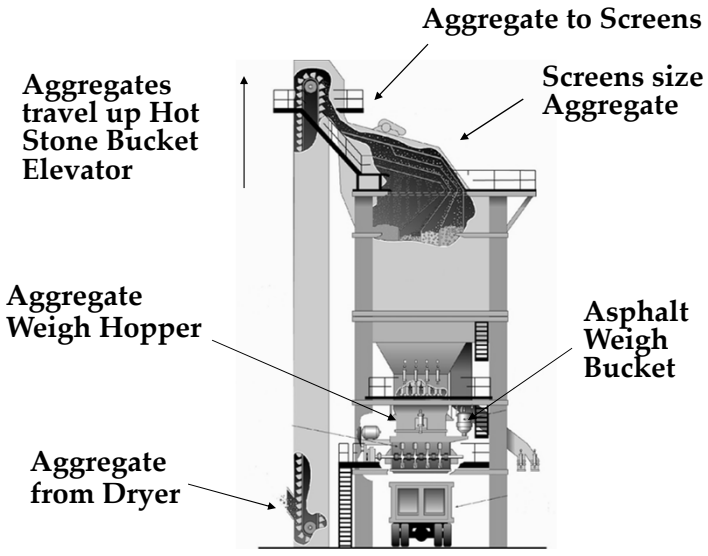
Batch Tower



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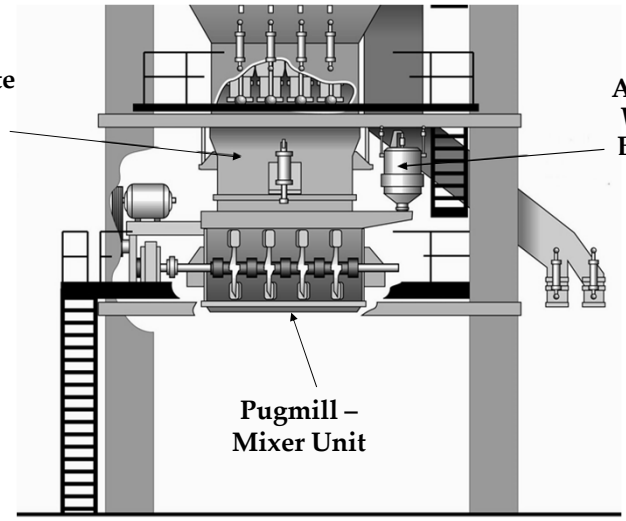
Hot Bins



Hot Mix Produced One Batch At A Time

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Pugmill

The Pugmill usually receives dry aggregate followed by the asphalt cement.

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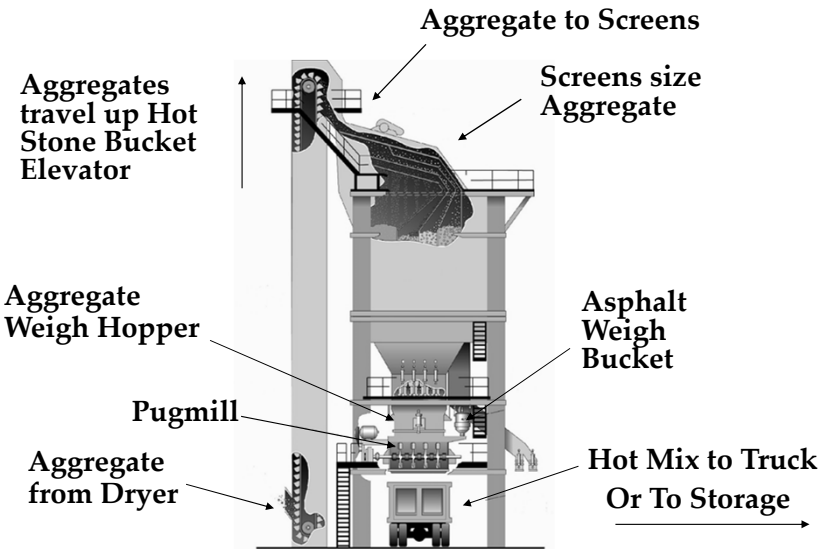
Batch Tower



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Loading Truck Straight from Batch Plant

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Drum-Mix (Continuous) Plant Facility

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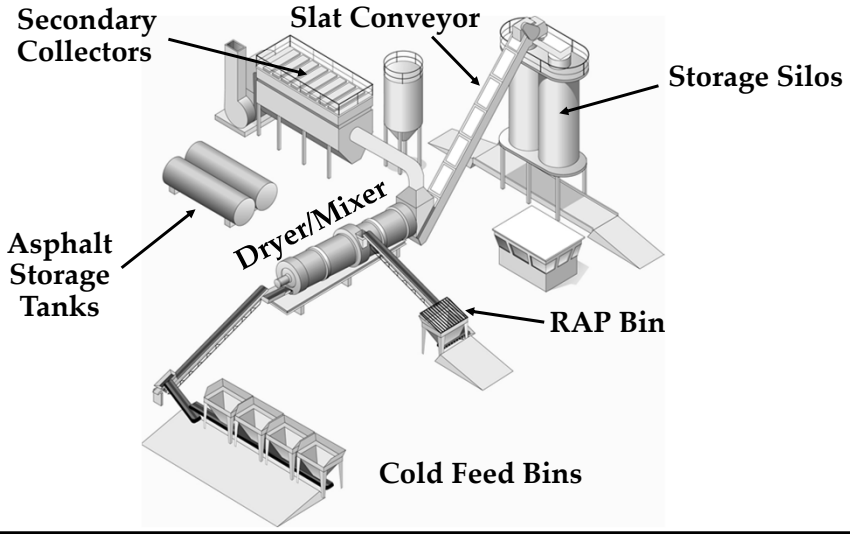
Drum-Mix Facility



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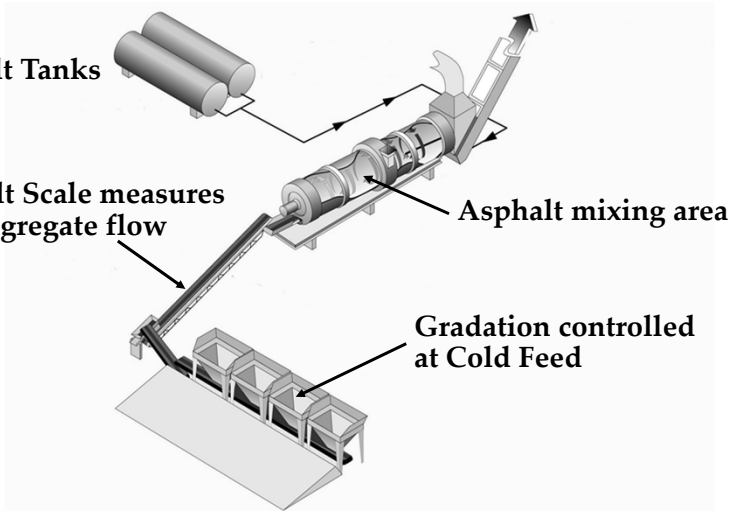
Material Flow - Drum Mix



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Types of Drum-Mixers

- New types of drums have been introduced since the 1980's.
- Environmental excellence is the goal.
- All are called "drum-mixers".

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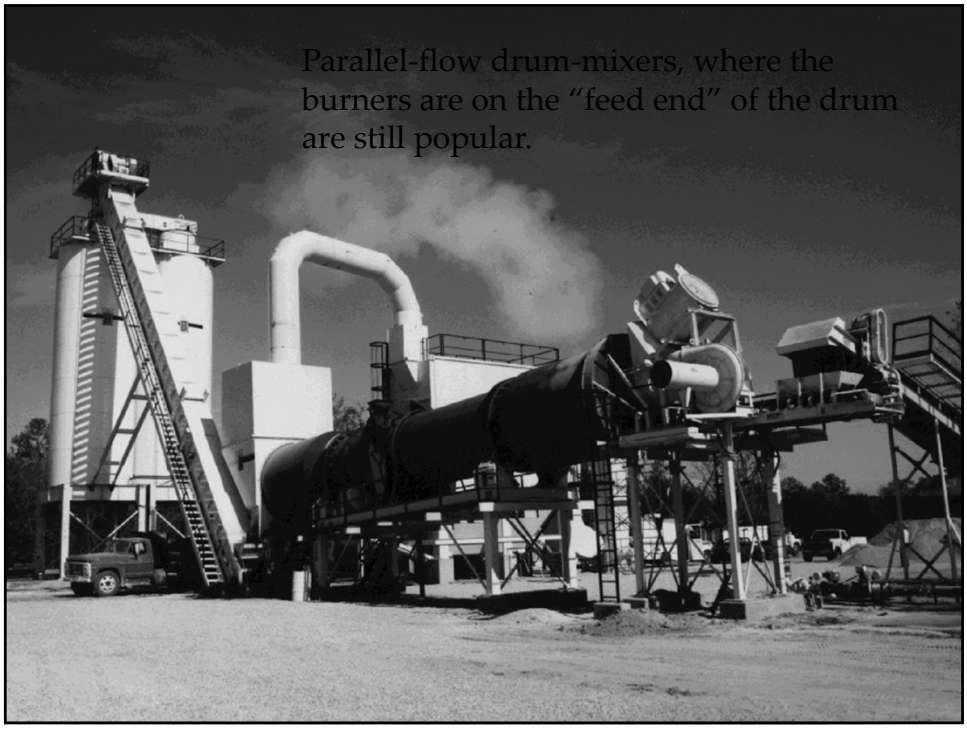
Parallel-flow drum-mixers, where the burners are on the "feed end" of the drum are still popular.

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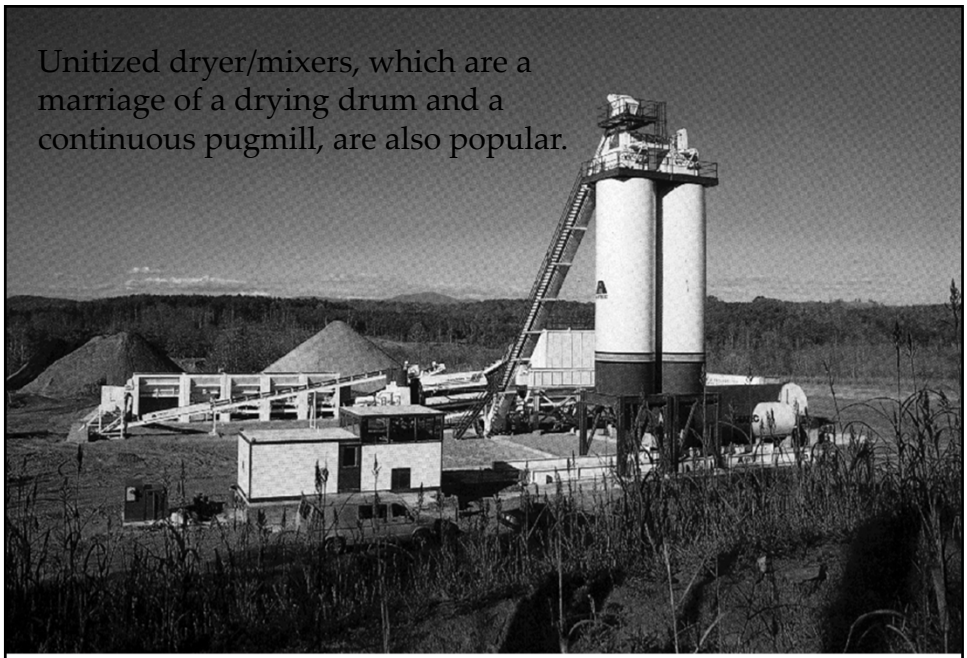
Unitized dryer/mixers, which are a marriage of a drying drum and a continuous pugmill, are also popular.

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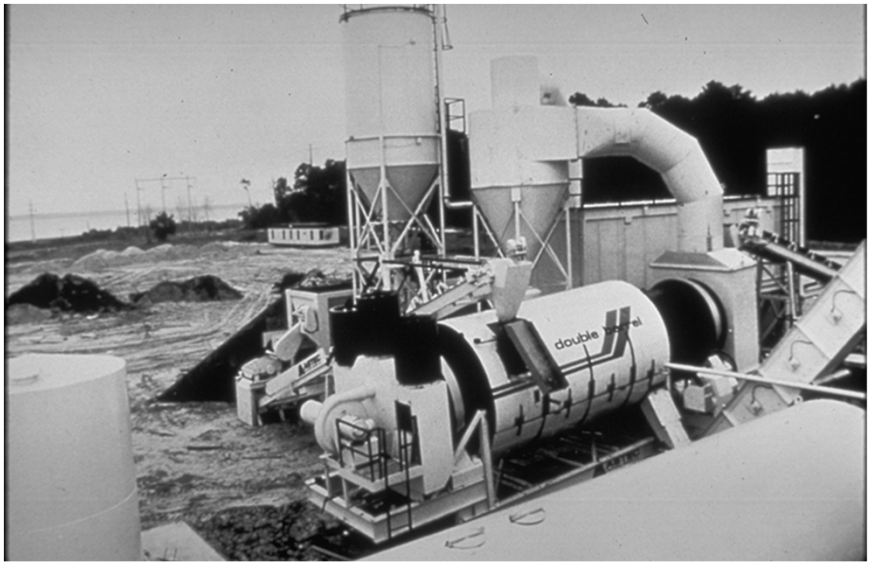
Counter-flow drum-mixers, where the burner flame is up inside in the drum, and the aggregate flows toward the flame

55

Small Drum Mixer Plant



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Sometimes Things Still Go Wrong

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Batch or Drum-Mixer?

Which is Best?

Choice based on business factors.

Both make quality mix.

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QUESTIONS ?

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APPENDIX A

Advantages and Disadvantages of Batch vs. Drum-Mix Facilities

Millions of tons of specification hot-mix produced over the last 25 years have proven to both contractors and regulatory officials that the highest quality of mixes can be produced from either a batch- style or drum-mix facility. However, based on local market conditions, contractors may favor one style over another. The general debate over the "batch vs. drum" argument centers on the following commonly held perceptions. Some are true, some are false.

Batch facilities offer greater flexibility when making different types of hot mix from one truck to another, particularly in small lots.

True: Batch plants are favored in metropolitan markets, or in markets where unpredictable quantities and types of mixes must be produced from the plant each day, and from load to load.

To gain the same type of mix flexibility with a drum-mix plant, you need additional silos. Even with many silos, it is difficult for a drum-mix plant to produce small quantities (for example, ten tons or Jess) for an individual load.

New batch facilities are more expensive to purchase than drum-mix facilities.

True: When a plant is being purchased for a specific large project, or contract work involves a discrete mix to be produced at a given time, contractors typically lean toward purchase of a drum-mix facility.

There is more equipment associated with a batch-style plant than with a drum-mix plant.

Batch plants, because of the additional moving and wearing parts, are more expensive to operate and maintain than drum-mix plants.

True: Batch facilities carry slightly higher operating costs for the owner as there is more equipment to run and maintain. In addition, the electric motors consume energy. Purchase of a new batch plant is weighed carefully against the advantages a batch plant might offer in a given local market.

Because batch plants have been produced since the tum of the century, while drum-mixers have been produced only over the last 25 years, it is easier to find and less expensive to purchase a used batch plant than a used drum-mix plant.

True: The fact that the overall batching concept has remained unchanged over the years makes a used batch plant a viable, cost-effective production tool for market expansion or a given project.

Batch facilities can be used to correct gradation problems with virgin aggregates if gradation quality control is suspect.

False: To a limited degree, batch facilities can help adjust gradation with the feed aggregates. Each feed bin and feed material has its own gradation. Once the aggregate is combined and dried, the batching tower separates the aggregate by four or five screen sizes, depending on whether it has four or five hot bins. Percentages of material between these screen sizes, however, cannot be adjusted for quantity with a batch plant.

Drum-mix facilities allow the use of greater percentages of RAP (Reclaimed Asphalt Pavement) in the final mix.

False: Historically, the practical limits for percentages of RAP (Reclaimed Asphalt Pavement) that could be used in a batch plant hovered around 25 percent, while the percentages of RAP that could be used in a drum-mix plant approached and often exceeded 50 percent.

Recent developments in recycling equipment that can be added to a batch plant allow these plants to produce recycled mixes with RAP percentages higher than 25 percent.

Drum-mix plants can out-produce batch plants.

False: Both drum-mix and batch plants are sized based on production rates. There is a commonly held opinion in the field that a 275 ton-per-hour drum plant can out-produce a 275 ton per hour batch plant over a day's run. In reality, this perception is false. Some truth is given to the argument due to the field coordination of the plant and the paving operation. A drum-mix plant must produce on a continuous basis, and because stopping production is more difficult than holding back a batch in a batch plant and shutting off the feeders to the dryer, field managers have a tendency to schedule the haul traffic from a drum-mix facility more closely. The result of this improved management is more production for the duration of a full day's paving.

A batch plant of equal size equipped with silos and operated without stopping will produce the same amount of mix over a given shift as a drum plant equipped with silos and operated without stopping.

MODERN HMA PRODUCTION FACILITIES

Glossary of Keywords

Batch	The amount of hot-mix made at one time in a batch plant.
Batch plant	A hot-mix asphalt facility that produces hot-mix a "batch" at a time, or one load at a time.
Belt scale	A device used to measure aggregate continuously as it flows up a belt conveyor.
Drum-mix plant	A hot-mix asphalt facility that produces hot-mix in a continuous-flow process.
Dry mix cycle	The phase of the batch-mixing cycle before asphalt has been added.
Hot bins	The storage bins in a batch tower that hold the dried, sized aggregate that is ready for mixing.
Pugmill	The device used to mix aggregate and asphalt in a batching style plant.
Tower	The common term for the tall portion of a batch plant that contains the hot stone elevator, screens, hot bins, aggregate weigh hopper, asphalt weigh bucket, and pugmill.
Weigh bucket	Common reference to the device in a batch plant that is used to weigh asphalt.
Weigh hopper	Common reference to the device in a batch plant that is used to weigh dried aggregates.
Wet mix cycle	The phase of the batch-mixing cycle after asphalt has been added.

2.1 INTRODUCTION

Modern HMA production facilities have evolved into two basic types of plant configurations: "batch" and "continuous flow" (drum-mix). Both types of facilities, regardless of plant age, can be equipped with all the requirements for modern, up-to-date HMA production, including computerized control automation, recycling systems, and additional equipment for bulk and liquid material additives. Either type of facility can produce consistent, high quality hot-mix to meet the specified job-mix formula.

2.2 BATCH-TYPE FACILITIES

Batch-type facilities as shown in figure 2.1, have been common since the turn of the century and have changed little in overall concept. They produce hot-mix asphalt a "batch" at a time. Aggregates and asphalt are weighed individually and then mixed together and dispensed into a truck or storage equipment a "batch" at a time.

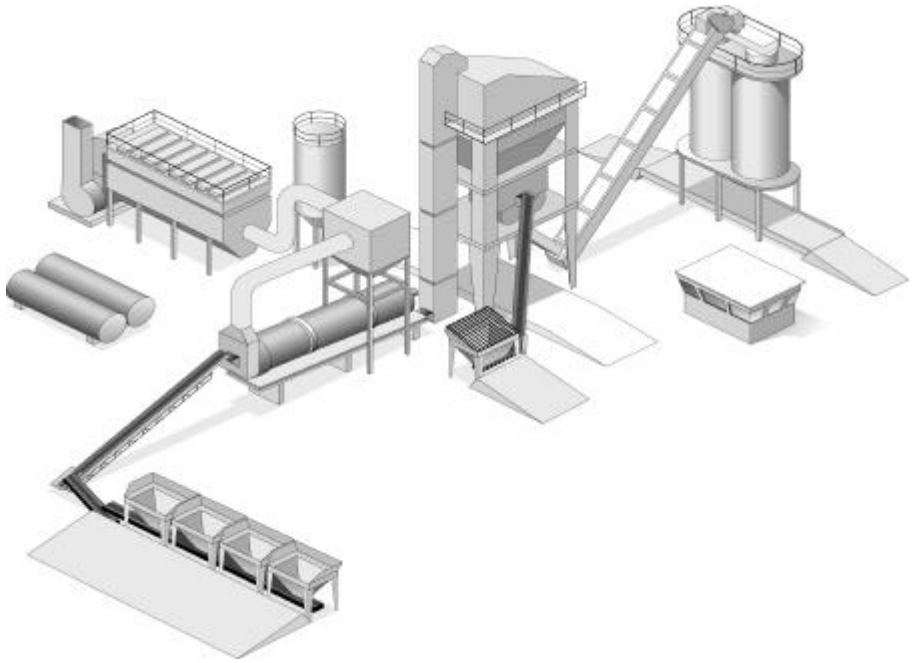

Figure 2.1 Typical asphalt batching style plant.

Figure 2.2, taken from the patent files of 1901, illustrates the individual activities and steps in a batch-style facility. While the equipment has changed over the years, the overall concept is the same.

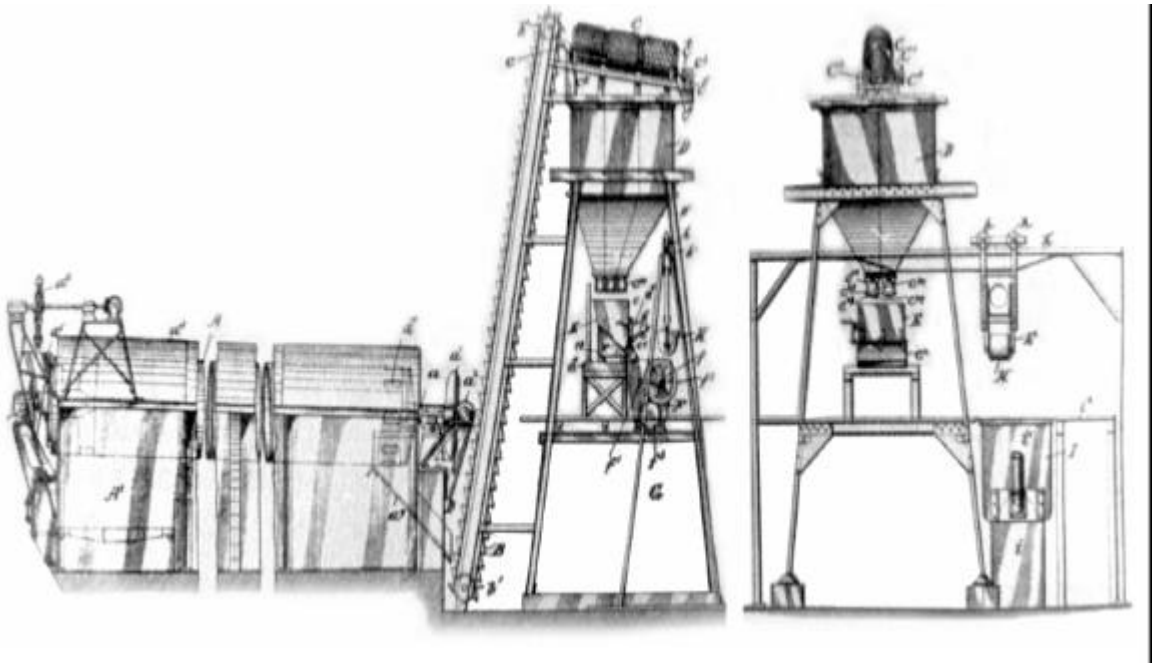

Figure 2.2 Warren Brothers patent drawing for batch plant.

In a batch-style facility, once aggregate is dried it is conveyed to the top of the screening section with a bucket elevator. The patent illustration, figure 2.2, depicts an open bucket elevator and an open, cylindrical, trammel-style-screening unit. Modern facilities, as shown in figure 2.3, use enclosed bucket elevators and enclosed screening towers for dust control. Screens are now typically horizontal or inclined vibrating units, rather than the rotating cylindrical style shown in the original patent applications. Both of these illustrations are useful in depicting the key functions being performed in a batch-style plant.

At the screening unit, the aggregate passes over different screens that separate the aggregate into different sizes.

Sized aggregate is stored in the "hot bins," so called because they contain the hot, dried aggregate, which is waiting to be dispensed into the aggregate weigh hopper. These bins are also called "supply bins." The gates below them are frequently referred to as "supply gates." The batch operator either manually or automatically "draws" material from each hot bin to match the job-mix formula and weighs the aggregate in the aggregate "weigh hopper," which is positioned directly below the hot-bin gates.

Asphalt is pumped into the asphalt "weigh bucket," where it is weighed to the required amount. In modern, automated plants, the aggregate weighing and asphalt weighing is done simultaneously to shorten the batch cycle.

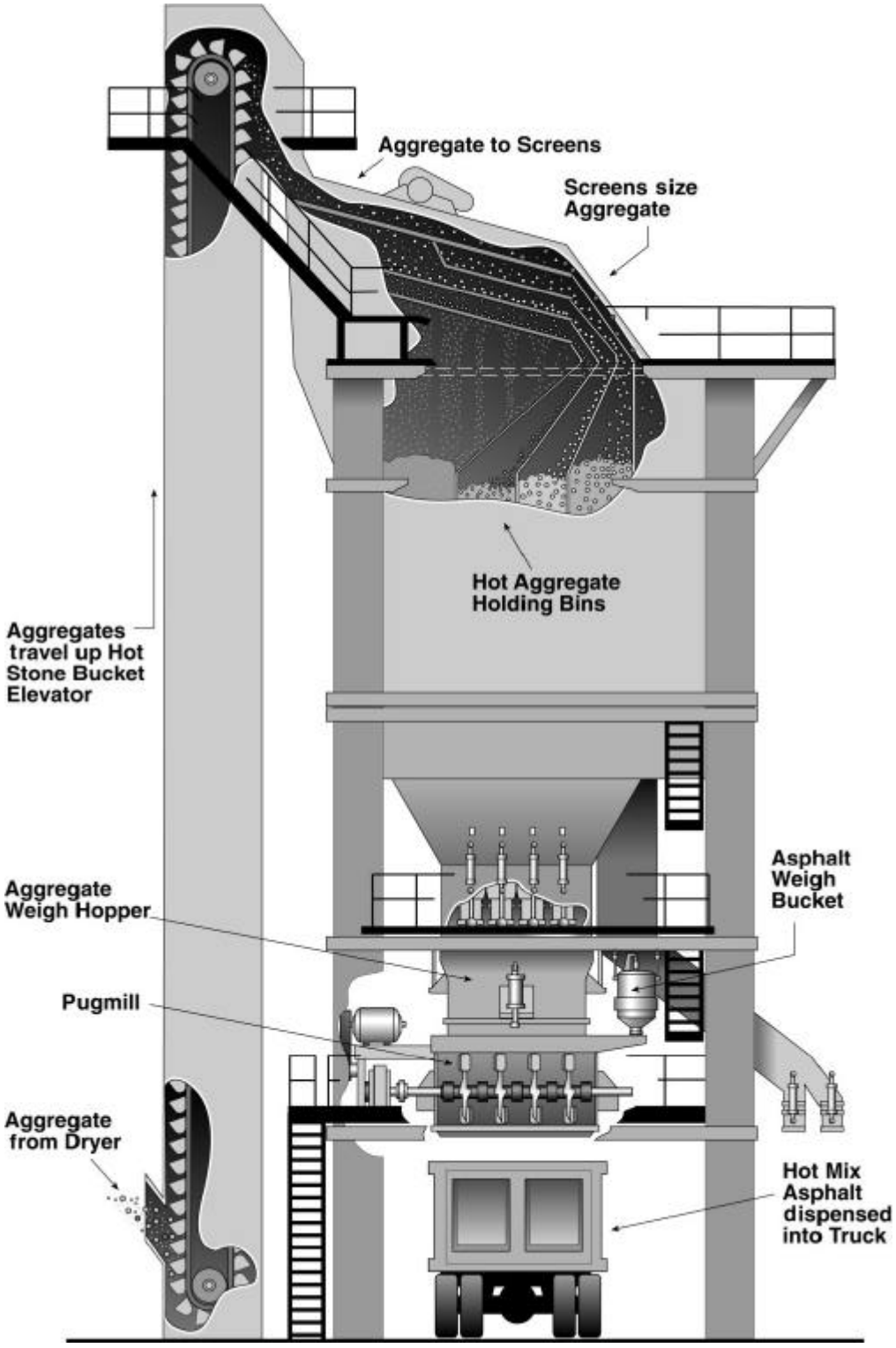

Figure 2.3 Flow of material in batch tower.

The aggregate is discharged from the aggregate weigh hopper into the "pugmill," where it is mixed for a brief period of time without asphalt cement to thoroughly mix the aggregate from each supply bin. This is called the "dry-mix cycle." After the dry-mix cycle, the asphalt cement is discharged into the pugmill, where it is mixed with the blended aggregate in a "wet-mix cycle." The hot-mix is then dispensed into a waiting vehicle or into transfer equipment for storage in a silo. Figure 2.4 displays the gradation and asphalt control in batch plant.

The size of the batch will depend on the size of the facility and the discretion of the plant operator. Batch plants are sized by the tonnage in the batch. While facilities have been produced over the years with capacities from 1/2 tonne to 18 tonne, typical sizes found in the field range from 1-3/4 tonne to 5 tonne.

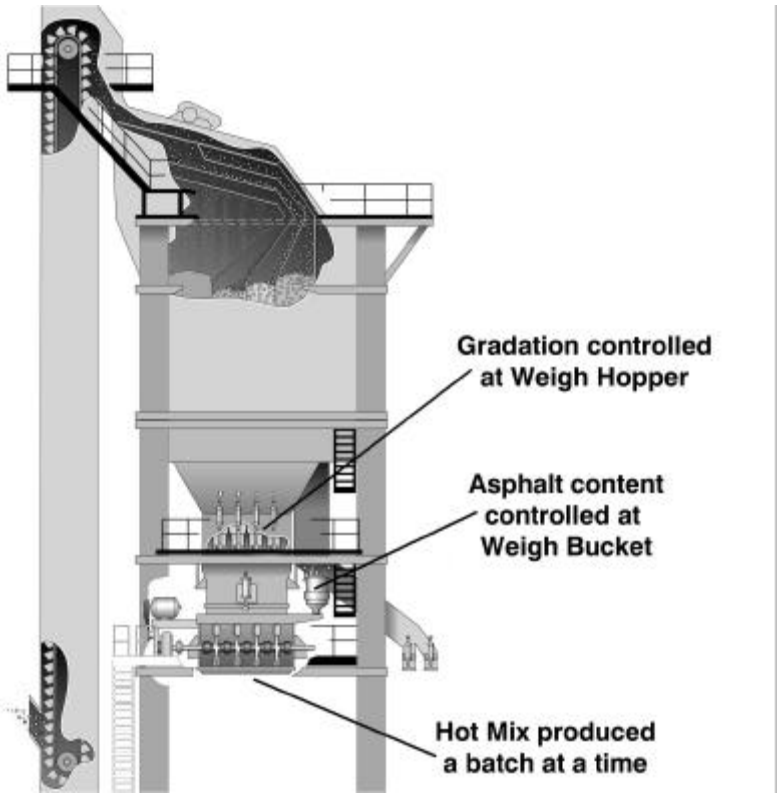

Figure 2.4 Gradation and asphalt control in batch plant.

Batch plants are shown in figure 2.5. The key concepts here are that final aggregate gradation is determined in the "tower" from the supply bins, that asphalt content in determined with the asphalt weigh bucket, and that mix is produced a batch at a time.

Figure 2.5 Modern HMA batch facility.

Although the concept of continuous-flow plant facilities shown in figure 2.6 is not new, the continuous-flow or drum-mix facilities we are most familiar with today include:

- Parallel-flow drum-mixers popular from the early 1970s to the late 1980s,
- The counter-flow drum-mixers popular since the late 1980s and,
- The modern dryer/mixer facilities such as the unitized plant.

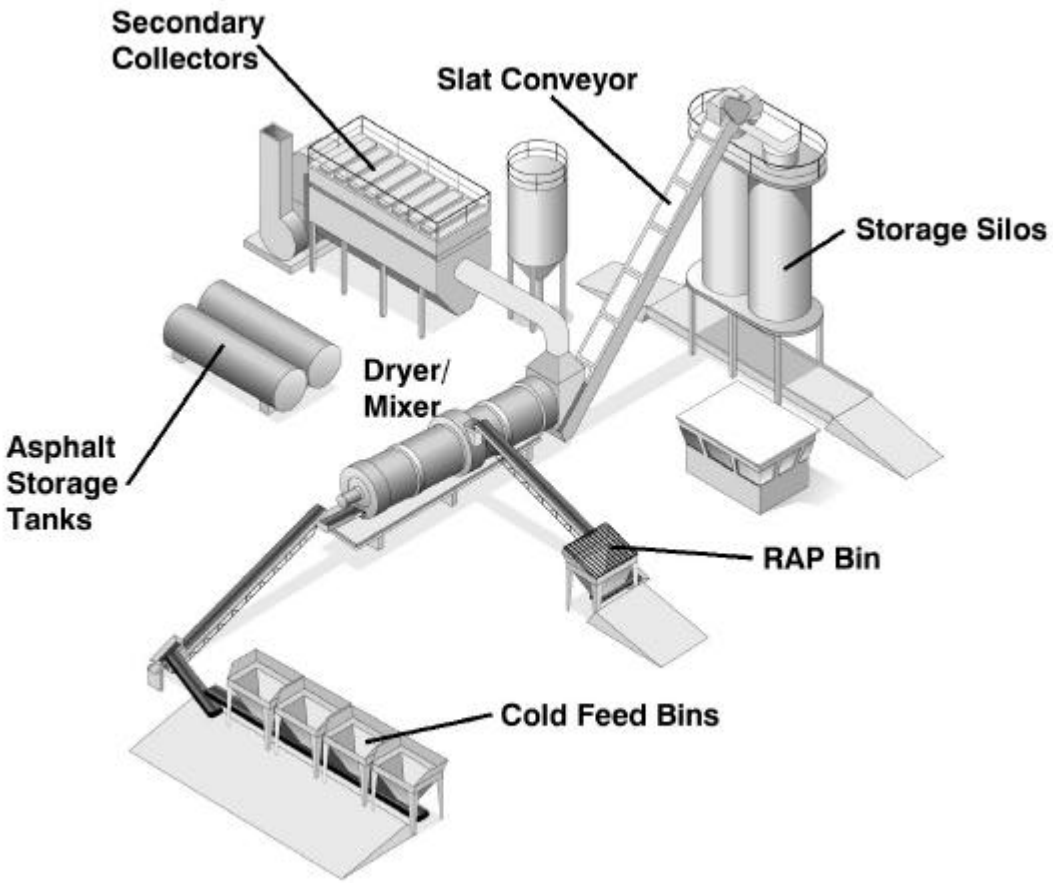

Figure 2.6 Typical "drum-mix" (continuous-flow) facility.

The primary difference between these continuous-flow or drum-mix facilities and a batch-style facility is that aggregate is sized, blended, dried, and mixed with liquid asphalt in a one-step continuous process, rather than the batch-at-a-time process common with the batch-style facility.

All drum-mix or continuous-flow plants control gradation at the aggregate feeders, unlike a batch-style plant that has sizing screens at the top of the batching tower to size the aggregate, and holding bins and a weigh scale for proportioning the mix formula.

It is important to note that these plants operate under the assumption that properly sized aggregate is being delivered to each of the cold-feed bins. The plant automation controls the proportioning of each aggregate by varying the flow rate from each cold-feed bin, typically with electronically controlled variable-speed belt conveyors at the individual feeders. Figure 2.7 shows the flow of material through a "drum-mix" (continuous flow style facility). The only screens installed in continuous flow plants are for "scalping purposes," (i.e., rejecting oversized tramp materials from the mix blend).

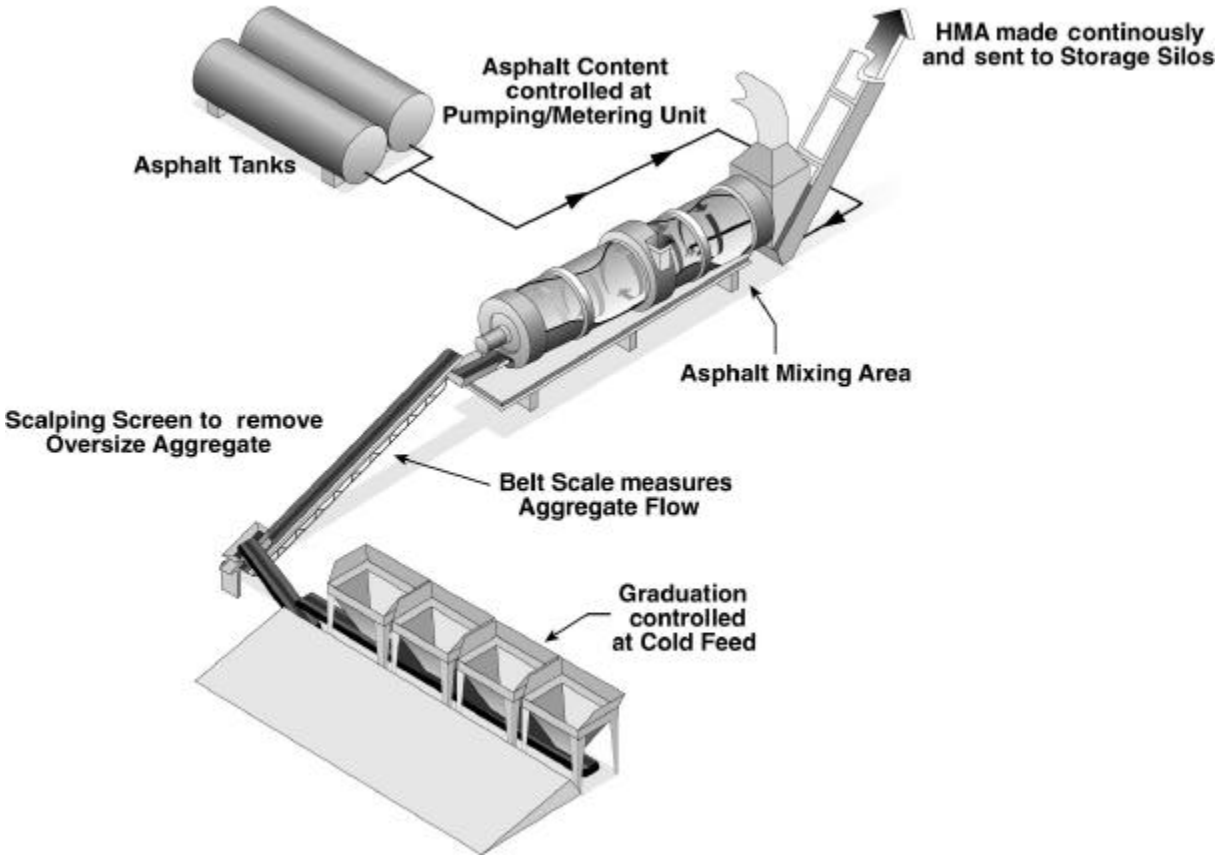

Figure 2.7 Flow of material through a "drum-mix" (continuous flow style facility).

Asphalt is also proportioned and blended on a continuous basis. The combined aggregate is weighed as it enters the dryer with a belt scale. The asphalt cement is then proportioned on a continuous basis with the aid of a flow meter and flow control system to match the weight of this aggregate stream. The proper proportioning and timing of the asphalt cement flow is controlled automatically.

Because the mix is being produced on a continuous basis, the finished product must be stored for dispatch into a haul truck. This is typically done with overhead storage silos.

Although technically inaccurate, the term "drum-mixer" is typically used in the field to denote a continuous-flow type plant. In the 1970s and 1980s, a significant number of parallel-flow drum-mixers were manufactured and sold. Plant manufacturers used the term "drum-mixer" to refer to this style facility.

Regulatory specifications and educational materials had to be rewritten to include this new style of continuous-flow plant. The terms "batch plant" and "drum-mix plant" became common references for the two types of modern hot-mix facilities. Figure 2.8 displays the modern parallel-flow drum-mix facility.

Figure 2.8 Modern parallel-flow drum-mix facility.

In the late 1980s, however, plant manufacturers began experimenting with more environmentally sensitive designs for recycling, drying, and mixing. Each manufacturer's goal was to create a plant design with the cleanest possible emission discharge and the highest possible percentage of reclaimed pavement that could be used in the new hot-mix.

Several new styles of hot-mix plants evolved from this design period. Today there are counter-flow drum-mixer facilities, unitized dryer/mixer facilities, and separate dryer-mixer facilities. Figure 2.9 shows a modern unitized facility and figure 2.10 illustrates a modern counter-flow drum-mix facility.

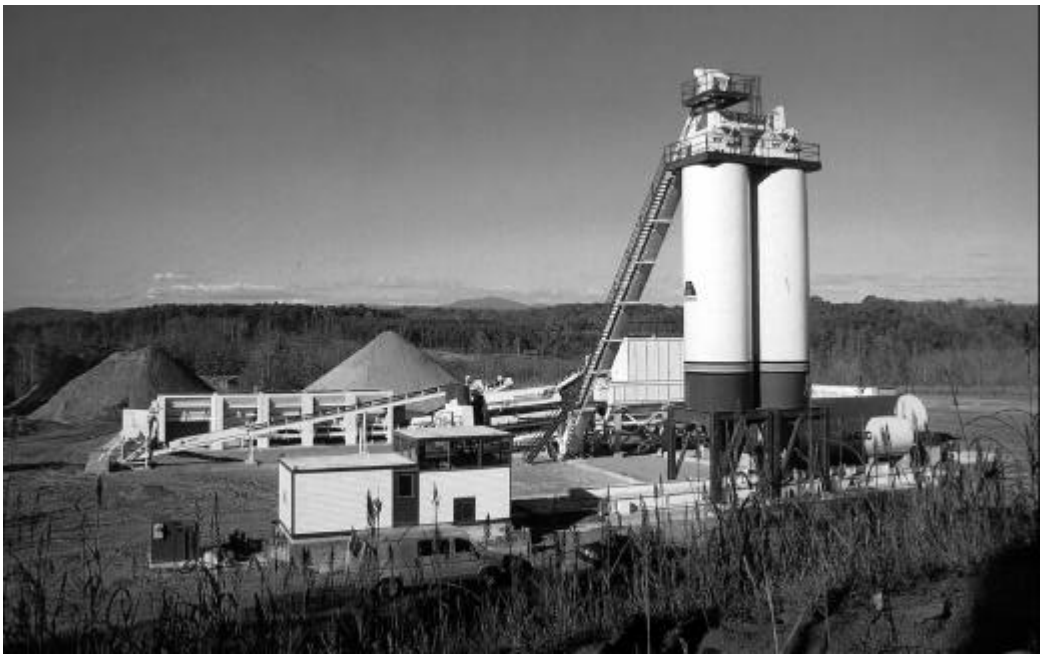

Figure 2.9 Modern unitized facility.

Figure 2.10 Modern counter-flow drum-mix facility.

To minimize confusion and to standardize specifications by regulatory agencies, all of these facilities are typically referred to under the umbrella of "drum-mix facilities" or "drum-mix plants." Therefore, this manual refers to all types of plants where hot-mix is made on a continuous basis as a drum-mix plant or a drum-mix facility.

2.3 BATCH OR DRUM-MIX: WHICH IS BEST?

There is considerable debate in the field about whether a batch plant or a drum-mix plant is the best choice of equipment for getting the job done. As is expected, both contractors and regulatory officials hold different opinions with conviction. Appendix A addresses the typical topics in the "drum-mixers vs. batch plants" discussion.

Ultimately the choice between a batch plant and a drum-mixer plant depends on business factors such as purchasing costs, operating costs, and the flexibility required for local market conditions. Both types of plants can produce equal quality virgin or recycled mix.

2.4 REFERENCES

1. FAA Circular AC 150/5370-14, *The Hot Mix Asphalt Paving Handbook*, pp. 2:1-9.