

Technical Paper T-138

HOT MIX

GLOSSARY

**A glossary of terms related to
the production of hot mix asphalt**

by Frank H. Eley, Jr

Credits

We wish to acknowledge and thank those that provided valuable information and reviewed appropriate portions of this glossary:

J. Don Brock, President, Astec Industries, Inc.
Herb Jakob, Corporate Dev Mgr, Astec Industries
Bill Gray, Chief Engineer, Telsmith Inc.
Mike Blantz, Hauck Manufacturing Co.

Astec Division:

Norm Smith, President, Astec Division
Gail Mize, Sales Executive VP
Malcolm Swanson, Engineering VP
Eddie Bingham, Purchased Parts
Noelle Currey, Acoustician
Randall Carroll, Structural Engineer
Ray Carroll, Double Barrel Group Leader
Carole Cheek, Sales Coordinator
Floyd Cheek, Controls Sales Manager
Terry Dobson, Baghouse Group Leader
Earl Edwards P.E., Project Engineer
James Edwards, Service VP
George Hackworth, Silos Group Leader
Drennon Hall, Traffic Manager
Dave Hampton, Marketing Services Manager
Mark Harned, Controls Director
Rick Hodge, Service Technician
Mike Johnston, Storage Systems Group Leader
Joe Ketchum, Safety
Martin McCanless, Engineering Manager
Bob Marlin, Cold Feed Group Leader
John Milstead, Chief Engineer
Gil Morgan, Batch Tower Group Leader
John Nail, Purchasing Manager
Tommy Paris, Baghouses
Greg Renegar, Product Design Engineer
Paul Shelton, Advertising Director
Tom Standard P.E., R&D ME
Simon Stanley, Senior Controls Engineer
Fate Thomas, Parts Technician
Mike Uchytill, International Sales VP
Amy Wakim, Structural Engineer

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Gene Farrow, Vice President
Tom Wilkey, Director of Sales and Marketing
Jeff Beavers, Regional Sales Mgr
Jerry Vantrease, Regional Sales Mgr
Buddy Ledford, Applications Engineer
Bryan Eley, Electrical Engineer
Michael Swanson, Mechanical Engineer
Greg Jones, Engineering Lead Man
Gib Ivey, Draftsman
Shannon Putman, Draftsman

Preface

This glossary defines almost 400 terms frequently used by people in the hot mix asphalt industry. Most are names of equipment, materials, and processes. The terms are generally unknown to people who do not work in the industry. Moreover, the terms are not usually defined in standard dictionaries, or at least not as they are used in the HMA industry.

This glossary was initially prepared to aid in translation of ads, brochures and technical papers into other languages. But I believe it can benefit virtually anyone in the industry. Many know a lot about one subject, but little about others. Thus, this glossary makes it easy to learn about unfamiliar subjects.

The terms and definitions came mainly from people at Astec and Heatec. When writing this glossary, Frank questioned dozens of people. He wrote definitions based on their explanations and had them to review the copy for accuracy.

We hope to periodically update this glossary. If you have any suggestions, please contact Frank Eley, at 423-821-5200.

A free copy is available to individuals upon request.

Jim May,
President
Heatec, Inc.

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abrasion. The process of wearing down or rubbing away by means of friction. Most abrasion in HMA equipment is caused by aggregate. Special abrasion-resistant materials are often used in equipment to reduce wear.

AC. Abbreviation for asphalt cement.

acoustician. A person who specializes in the field of acoustics. HMA plant manufacturers may engage acousticians to assist their engineers and customers in noise control. Acousticians may measure complex acoustical characteristics as well as sound pressure levels at a plant site, analyze the measurements and recommend noise control solutions.

acoustic tile. A sound deadening material commonly used in the ceiling of control houses of HMA facilities.

additive tank. A tank for liquid additives, such as anti-stripping agent, often mixed with AC to reduce stripping.

aggregate. Inert material such as sand, gravel, crushed stone and slag used as the chief ingredient of HMA.

SAND is a fine granular material (usually less than 1/4-inch dia.) produced by natural disintegration of rock or by crushing friable sandstone rock or other suitable rocks.

GRAVEL is a coarse granular material (usually larger than 1/4-inch dia.) produced by natural erosion and disintegration of rock.

CRUSHED GRAVEL is produced by artificially crushing gravel, causing most fragments to have at least one fractured face.

CRUSHED STONE is produced by artificially crushing rocks, boulders or large cobblestones, causing the fragments to have all fractured faces.

ROCK suitable for making good aggregates is formed all over the world and used to make crushed stone, sand and gravel.

SLAG, is the air-cooled, non metallic by-product of a blast furnace operation. It consists essentially of silicates and aluminosilicates of lime and other bases.

air bag suspension. Flexible bags pressurized with air and used to support the chassis of portable HMA equipment and other trucking

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equipment. Made of rubber reinforced with fabric and steel wire, they are commonly used in lieu of steel spring suspension systems.

air cannon. A device that “shoots” bursts of compressed air into material to loosen it and make it flow better. Commonly used in bins that hold aggregate and RAP.

air cylinder. A mechanical actuator powered by air pressure. Air cylinders are commonly used to operate valves or other components of a HMA facility. They consist mainly of a cylinder and an actuating rod. They are available in a wide variety of types and sizes.

air-to-cloth ratio. The numerical ratio of air flow to total filter surface area in a baghouse. Air flow is usually stated in cubic feet per minute (cfm). The total filter surface area is usually stated in square feet, determined by totaling the surface area of all filter bags in the baghouse.

Consider a baghouse with 448 filter bags, each 4-5/8 inches in diameter x 10 feet long, giving a total filter surface area of 5,421 square feet. Assume that the baghouse has an air flow of 29,960 cfm. Thus, the resulting air-to-cloth ratio is 5.5-to-1. This is the optimum air-to-cloth ratio for a baghouse in a HMA facility. The optimum ratio ensures that the baghouse exhaust will meet stringent clean air standards.

annunciator. See *first out annunciator*.

anti-stripping agent. An additive often used in HMA to make it less susceptible to stripping. It improves the adhesive bond between the asphalt cement and aggregate. Additives may be in the form of filler or liquid. Lime is the most popular anti-stripping agent and can be used as a filler or as a lime slurry. Liquid anti-stripping agents can also be added to the asphalt cement at the HMA facility. (See *stripping*.)

anti-stripping tank. A tank for storing liquid anti-stripping agent.

AR-360 steel. A high hardness abrasion resistant steel plate commonly used in HMA production equipment to minimize erosion from aggregate and dust. It has a Brinell hardness of 360.

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aramid. The generic name for a type of fiber from which temperature-resistant fabrics are made. Nomex, a trademark of Dupont, is a popular brand of aramid fabric. Aramid fabrics are used to make filter bags for baghouses used in HMA facilities. The bags are virtually unaffected by the high temperatures normally encountered while filtering dust from hot gases of the aggregate drying process.

ASME code. A set of design and fabrication requirements issued by the American Society of Mechanical Engineers for various types of pressure vessels. It applies to hot oil heaters and expansion tanks.

asphalt. Commonly used as a shortened term for asphalt cement, but may also refer to asphalt pavement.

asphalt cement. The binder or “glue” in HMA. Commonly abbreviated AC. At ambient temperatures asphalt cement is a black, sticky, semi-solid and a highly viscous substance.

Asphalt cements used in HMA are made by distillation of crude oil and are available in various grades. They are more suited for HMA than asphalt made from other materials or asphalt obtained from native deposits in various parts of the world.

Use of coal tar is avoided by the HMA industry because its fumes are known to be carcinogenic, posing a health hazard for anyone working with HMA. The word *bitumen* is used in many parts of the world to mean asphalt cement.

asphalt coiled tank. (See *coiled tank*.)

asphalt concrete. A dense-graded HMA. Also called asphaltic concrete or bituminous concrete.

asphalt metering system. A system that measures the flow rate of liquid asphalt cement and indicates the total amount used since the meter was reset to zero. The amount used is usually in gallons and the flow rate is usually gpm (gallons per minute). However, other measurement units can be used.

The standard metering package used by Heatec and CEI has two pumps. The system is commonly known as “a pump pushing a pump.” The system has proved to be reliable, has the accuracy needed and is cost effective. One pump is active and the other is

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passive. The active one functions as a conventional pump. The passive one functions solely as a flow meter. Liquid asphalt flowing through the passive pump causes its drive shaft to turn at a speed proportional to the flow rate. A tachometer on its shaft provides a flow rate signal to the computer and tachometer indicator in the control house.

The system has a temperature measuring system that corrects flow rate signals to allow for changes in volume due to temperature changes.

Other types of systems are also used for asphalt metering. (See *Brodie* and *mass flow meter*.)

ASTM A36. A structural quality carbon steel commonly used for structural components in a HMA facility.

attenuate. To reduce the level of sound. It may be necessary to attenuate the noise generated by equipment at a HMA plant to comply with noise ordinances or standards for hearing protection.

auger. (See *screw conveyor*.)

baghouse. Key component of a HMA facility. The baghouse filters dust from hot gases of the aggregate drying process. It consists of a large house-like structure which contains numerous filter bags.

It often has a pre-collector or cyclone section to drop out and collect larger dust particles before they reach the chamber containing the filter bags.

The baghouse has a large exhaust fan. The fan pulls in combustion air for the burner of the aggregate dryer. Its air stream flows through the dryer and baghouse carrying combustion gases from the burner plus dust and steam from the drying process.

baghouse fan. (See *baghouse*.)

baghouse fines. Dust collected by the baghouse. Baghouses with a cyclone separate most fines with particles larger than 200 mesh from those with particles smaller than that. Portions of the fines can either be returned to the mix or wasted.

ball joint. A type of piping joint used for asphalt and hot oil piping at a HMA facility. The joint swivels so as to eliminate the need for

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exact alignment of pipe lines. Their use makes installing piping much easier and reduces the time required.

ball valve. A type of control valve commonly used in hydraulic and pneumatic circuits. Two-way versions of the valve are often used at HMA facilities to either shut off or regulate flow. Three-way versions are sometimes used to switch flow from one circuit to another. All use a slotted ball that rotates 90 degrees to control the flow.

Ball valves are often used in piping of hot oil heaters and asphalt storage tanks. They are used in lines for hot oil, asphalt, fuel oil, or gas. When used for asphalt, the valve usually has a hot oil jacket.

An actuator, such as a pneumatic cylinder, can be used to operate the valve through its 90 degree stroke.

bar grizzly. A grill or network of bars which passes material small enough to go through the spaces between the bars and withholds or separates material larger than the spaces between the bars. Grizzlies are available with various bar spacing.

batcher. A container that collects HMA from a conveyor and drops it as a batch into another bin. Batchers are used on surge and storage bins. Segregation is minimized by dropping the material as a batch or slug instead of allowing it to flow continuously into the bins. Moreover, the batcher facilitates weighing the material in the surge bin while the flow from the conveyor is interrupted.

batch facility. A site with equipment designed and set up to produce HMA in batches. Batch facilities usually have batch ratings that designate the maximum amount of HMA they can produce in a single batch.

The ability to vary the mix formula and batch size from one batch to another makes the batch facility quite versatile. Thus, a batch facility has an advantage over a continuous mix facility when making a wide variety of mixes.

batch plant. A *batch facility*.

batch tower. A major structural unit of a batch facility. The tower contains screens that separate aggregates into sizes. It has bins that

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store the hot aggregates. It has a hopper that collects and weighs the aggregates. A pugmill in the bottom of the tower blends and mixes the aggregates and AC.

belt conveyor. A continuous moving belt commonly used in an HMA facility to transport aggregate or RAP from their storage bins to a dryer or mixer. A belt conveyor is not usually inclined more than about 22 degrees to prevent material from sliding back down the conveyor belt.

belt feeder. A belt-conveyor that feeds aggregate or RAP from its bin onto another conveyor. It often has a precision variable-speed drive to ensure accurate mix formulas. A variable-speed drive also permits changing the production rate without changing the mix formula.

On Astec feeders, a hi-torque a.c. motor runs at a constant speed. The motor drives the belt through a magnetic clutch. The clutch is powered by eddy currents to precisely vary its slippage. Thus, controlling the eddy currents controls belt speed.

A tachometer on the tail shaft gives a reliable indication of belt speed to ensure accurate blending, even if the belt slips on the head shaft.

belt scale. A scale usually incorporated in the incline conveyor of continuous mix HMA facilities. It has a load cell that accurately indicates the weight imposed by a section of the belt running over a weigh idler. This information combined with the belt speed denotes how much material is entering the dryer drum.

The scale incorporates a test weight for initial calibration. Material calibration is done by running sample material across the scale. The sample is diverted to a container and weighed on an independent scale. Scale indications are compared. If necessary, the belt scale is calibrated to agree with the test scale.

bin. A container for holding HMA or ingredients used to make HMA. (See *cold feed bin*, *surge bin* and *storage bin*.)

binder. Used alone, binder usually refers to the material used in HMA to bind the materials together. The most common binder material is asphalt cement. The binder also prevents the entrance of

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moisture, and serves as a cushioning agent. In some cases the binder waterproofs the entire road surface.

Bindicator. A registered trademark of the Bindicator Company for a bin level indicator. (See *bin level indicator*.)

bin level indicator. Bin level indicators alert the operator of high and low levels of material in a silo, surge bin or batcher. Two types are commonly used. One is an electro-mechanical rotary type and indicates a point level. The other is a radio-frequency type and also indicates a point level.

The radio frequency indicator is mounted on top of the silo or surge bin and has a sensing probe that extends down into the silo. The probe of the high bin indicator is short. The probe of the low bin indicator is long. When the mix rises and touches the probe, a radio-frequency circuit senses the contact and activates an electrical circuit. When the mix goes below the probe, the circuit is de-activated. Thus, the point height of the mix is indicated by whether the circuit is activated or de-activated.

The rotating indicator works in a similar way. It has a paddle on a rotating shaft that extends down into the batcher or silo. The shaft of the high bin indicator is short. The other is long. When the mix rises to block a paddle its shaft stops turning. When the mix goes below a paddle its shaft starts turning again. Thus, the point height of the mix is indicated by whether the shaft is blocked or turning.

Point level signals are transmitted to the control house to keep the operators informed of the bin point levels so they can take appropriate action.

Rotary indicators are installed in the sides of lime and dust silos instead of the tops. On side installations the indicators are placed at the heights or levels they sense. Thus, extensions are not needed on the paddles. (See *Bindicator*.)

bin vibrator. A device used on cold feed bins and RAP bins to prevent its material from sticking to the walls of the bin.

bitumen. Used in many parts of the world to mean asphalt cement. (See *asphalt cement*.)

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blue smoke. An unwanted substance sometimes produced when light ends from liquid asphalt cement are vaporized. Various methods are used to minimize or eliminate blue smoke.

blue smoke condenser. A heat exchanger used on tanks of heated asphalt cement to minimize air pollution. It condenses gas vapors, commonly known as blue smoke, produced by heating light ends (volatile organic compounds) often present in the liquid asphalt cement. Condensing the vapors turns them into a liquid state wherein they return to the liquid asphalt cement instead of escaping into the atmosphere through the tank vents or exhaust stack.

booster heater. A standard hot oil heater sometimes used with a direct-fired tank that incorporates scavenger coils to heat oil for other plant components. The booster heater increases the temperature of the oil after it is heated initially by the scavenger coils in the tank. (See *direct-fired tank*.)

Booster heaters are also being used to increase the temperature of virgin asphalt after it is delivered to a HMA facility, before it is used to make polymer modified asphalt cement (PMAC). Virgin asphalt must be at a temperature of about 410 degrees F when it is mixed with polymers. Thus, its temperature must be increased if the supply truck delivers it at a lower temperature. The booster heater boosts the temperature of the asphalt as it is pumped into the mixing equipment. A conventional helical coil heater can be used for this purpose. Instead of circulating hot oil through the helical coil as in conventional use, the virgin asphalt is heated as it makes a single pass through the helical coil en route to the mixer.

boot end. The foot or bottom of a hot elevator where the hot aggregate enters the elevator.

breaker. A circuit breaker. (See *circuit breaker*.)

Brinell hardness. A commonly used measurement of the relative hardness of metals and alloys. Brinell hardness is determined by forcing a steel ball into a test piece under standard test conditions and measuring the surface area of the indentation. Hardness is an important factor in the ability of steels and liners used in production equipment to resist the abrasion of HMA materials.

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Brodie. The trade name for a meter that indicates the flow rate of AC and indicates the total amount used. Other brands and types of meters are also used in HMA facilities. (See *asphalt metering system*.)

bucket elevator. (See *hot elevator*.)

bulkhead. A wall usually incorporated into cold feed bins and RAP bins to support a dirt ramp for front-end loaders. They are normally made of reinforced steel plate and keep the dirt out of cold feed mechanisms and suspension components. Bulkheads on some units fold for travel. Bulkheads are also known as *retaining walls*.

burner. A device that controls combustion of fuel in a dryer or other heating equipment. It may be set up to control various fuel oils or LP gas. Hauck is one brand of burner widely used in HMA equipment.

burner control panel. A control panel for monitoring and controlling the burner in a dryer or other heating equipment of a HMA facility. The control panel is usually one of several control panels in the control center of a HMA facility, but operates independently of others.

cable tray. A receptacle for supporting electrical cables that interconnect major components of a HMA facility. Cable trays help organize cables and provide them with some protection against accidental damage. They are designed to hold the cables without collecting dust, water and debris.

calibrate. To adjust equipment in order to make it function accurately or within pre-established limits. Many pieces of equipment used in a HMA facility require periodic calibration. The cold feed system and the asphalt metering system are two systems that require regular calibration. (See *belt scale* and *Brodie*.)

calibration tank. A tank used in calibrating the asphalt metering system used in a HMA facility. It is mounted on load cells that indicate the weight of the tank and its contents.

The metering system is checked by filling the tank with liquid AC and comparing its weight with the amount indicated by the

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metering system for filling the tank. If necessary, the metering system is adjusted to agree with test results.

cavitation. The sudden formation and collapse or implosion of low-pressure bubbles in a liquid while inside a pump. It can be caused either by “starving” the pump or by inadequate suction head (NPSH). Cavitation is a destructive force and can severely damage a pump if allowed to continue. It produces a rattling sound as if the pump were trying to pump gravel. See *NPSH*.

CEI. A company that specializes in designing and manufacturing asphalt heating and storage equipment for the HMA industry. CEI is a subsidiary of Astec Industries, Inc.

centrifugal pump. A type of pump widely used in the HMA industry. It has a rotating impeller that displaces liquid by centrifugal force. If the liquid encounters resistance that equals or exceeds the force created by the pump the impeller may continue to rotate without immediate damage, but will cease to displace the liquid. Compare *gear pump*.

ceramic tile. A material commonly used to line certain areas of HMA equipment to protect it against rapid wear. It is commonly used to line entry and discharge chutes of dryers and mixers and to line the cones of storage silos. Each tile has a metal grommet that allows the tile to be secured in place by plug welding.

Tile used for HMA equipment is a hard, brittle, heat-resistant, corrosion-resistant material made by shaping and then firing a powdered material (mostly aluminum oxide) at a high temperature. It is more resistant to abrasion than abrasion-resistant steel, but has lower impact resistance.

cfm. Abbreviation for cubic feet per minute.

chain. The type of chain used the most in a HMA facility is roller chain. (See *roller chain*.)

chart recorder. An instrument with a pen that draws a continuous line on a 24-hour circular chart to show material temperatures at all times during that period. On drum mix plants the chart shows the temperature of the mix in the discharge chute of the mixer. On

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batch plants the chart shows the temperature of the aggregate at the discharge chute of the drum dryer.

check valve. A valve commonly used in hydraulic and pneumatic circuits. It allows liquid or gas to flow only in one direction. A hinged gate in the valve automatically unseats and opens when pressure is applied to one side of it. The gate automatically seats and remains closed when pressure is applied to its opposite side. Some check valves use a spring-loaded ball instead of a hinged gate. Check valves are used in fuel oil and thermal fluid (hot oil) piping of heaters and asphalt storage tanks.

circuit breaker. An electrical switch that breaks or disconnects an electrical circuit when the current in the circuit exceeds the rating of the device. The breaker serves as a safety device to prevent electrical overloads from damaging wiring or other components in the circuit.

clam gate. A type of gate commonly used on bins and silos to control the material flowing out of them. Clam gates typically consist of two gates that swing over a curved opening to shut off the flow. The clam gate on a cold feed bin usually has a single gate at the opening in the bottom of the bin. It is adjustable and can be set to maintain the desired flow rate.

clean air plenum. An enclosure in a baghouse that carries clean air to the exhaust fan after it has passed through the filter bags.

cloth. The wire mesh material used in a scalping screen. (*See scalping screen.*) Cloth may also refer to the fabric used to make filter bags used in a baghouse. (*See filter bags.*)

CO. Carbon monoxide. A primary product of *incomplete* combustion. It is a known health hazard and subject to strict regulation.

coater. A machine that uses a single mixing shaft with paddles to mix ingredients of HMA. Sometimes called single-shaft pugmills. Coaters are normally used in continuous mix facilities known as drum mix coaters. The coaters are freestanding and work in conjunction with a drum dryer. The material leaves the dryer and

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enters one end of the coater. It is mixed and coated with liquid AC. It travels the length of the coater and is discharged at its other end. These facilities were popular before the advent of the Double Barrel mixer. (See *pugmill* and *mixer*.)

coiled tank. A type of heated tank for storing asphalt cement. The tank has several layers of pipe running the full length of the tank. Hot oil is pumped through the piping to heat the AC. The heat source for the hot oil is an external heater, *not* mounted on the tank.

cold feed bin. A bin used in a HMA facility to hold cold (unheated) virgin aggregate and feed it to a conveyor, which takes it to a screen and on to the dryer. Most HMA facilities have several cold feed bins to store three or more sizes of aggregate.

cold feed system. A group of related components for holding virgin aggregate and delivering it to the dryer. The components usually include several cold feed bins with feeder belts, collecting conveyors, scalping screens, weigh belt, and incline conveyor.

cold planer. Also called a milling machine. A mobile machine that removes old paving from a roadway by planing or milling. It has cutting teeth affixed to a rotating drum. It also has a belt conveyor that loads the removed material into a truck that moves along the road ahead of the machine.

collecting conveyor. A belt conveyor used under cold feed bins to collect the materials from the feeder belts of the bins. The collecting conveyor may empty onto another conveyor or onto a scalping screen. The end of the conveyor may be angled upwards.

combustion air. The amount of air needed for combustion of a specified fuel. It is the stoichiometric air plus excess air. (See *primary air*, *secondary air*, *tertiary air*, *excess air* and *leakage air*.)

combustion air pre-heater. A secondary heat exchanger sometimes used on a hot oil heater at a HMA facility to increase heating efficiency. It pre-heats the combustion air for the burner and can increase efficiency approximately 3 percent. It is also known as an air-to-air heater.

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The type most commonly used is a shell and tube heat exchanger, usually mounted in the exhaust stack of the heater. Hot exhaust gases pass through the tubes and heat the combustion air, which passes around the tubes. The fan is usually mounted on the cold air side of the pre-heater. (Compare with *economizer*.)

combustion chamber. An enclosed space in fired heating equipment for combustion of fuel.

condenser. A device often used on vents of tanks that contain materials that give off volatile organic compounds (VOCs) when heated. Condensers used on asphalt storage tanks usually have a number of tubes with external fins. The tubes are cooled by ambient air circulating through the fins. Thus, gasses exiting the tank are cooled as they flow through the tubes. The cooling causes vapors of the VOCs to condense and to drain back into the tank. This greatly minimizes the release of pollutants into the atmosphere. (See *vent*.)

concrete. A hard, strong manmade construction material consisting of sand, conglomerate gravel, pebbles, broken stone, or slag in a mortar or cement matrix. It is commonly used for building roads, bridges and architectural structures.

The word *concrete* is sometimes used with other words to designate another type of manmade construction material, for example *asphalt concrete*.

Note that *concrete* does not always refer to manmade construction materials. It can refer to substances formed in nature by the coalescence of separate particles or parts into one solid mass. An example is concreted earthy or mineral matter, such as rock.

conduction. A process of heat transfer by which heat flows within a medium or between different mediums in direct physical contact. The heat flows from a region of higher temperature to one of lower temperature. The medium may be solid, liquid or gaseous. The transfer is by direct molecular interaction, but with little displacement of the molecules. It is the only method by which heat can flow in opaque solids.

The key role of conduction in a helical coil heater is to transfer the heat from the outer walls of the coil to the thermal fluid flowing through the inner walls.

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conduit. Metal tubing through which electrical wiring is run to interconnect electrical parts of units. The wiring from one major unit to another may be interconnected either by wiring run in conduit or by rubber-covered electrical cables.

cone. A funnel-shaped bottom in a silo or surge bin. Some cones are known as mass-flow cones. These have side walls sloped 66 degrees to cause material above the cone to move en masse or all together. This type of cone minimizes segregation, but is usually more expensive to build than other cones.

containment. A secondary enclosure for tanks that contain liquids, usually fuel or asphalt cement. It functions to keep the liquid from escaping in the event of a leak or rupture in the primary tank. The main concern is for the environment. However, a containment can also minimize the impact that an accidental spill can have on operation of the HMA facility.

Containment enclosures are often no more than concrete walls built around a group of tanks. However, an individual tank often has a containment enclosure fabricated from steel. On portable tanks the containment enclosure usually consists of a second tank that fully encloses the main tank—a double-walled tank. On a stationary or relocatable tank the containment enclosure may enclose only the bottom portion of the tank.

continuous mix facility. A site with equipment designed and set up to produce continuous runs of HMA. Such facilities usually have ratings that designate the maximum amount of HMA they can produce per hour. Although continuous mix facilities can run virtually any mix design, they are at their best when making long runs of a single mix and when running at high production rates.

Storage silos greatly increase the versatility of such facilities. They provide surge capacity, enabling the facility to run without interruption. Moreover, a silo can store mix up to four days and, where two or more are used, each can store a different mix design.

control console. A steel cabinet that houses key controls and instrumentation for a HMA facility. A typical facility has several consoles installed in the control house. Related controls are grouped on the console.

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control house. A special building used to house the controls of a HMA facility and to provide accommodations for one or more persons operating the facility.

The building usually incorporates heating and cooling facilities. Its windows provide the operator with a good view of truck load-out and key equipment. The house has a welded steel structure capable of withstanding the rigors of travel and being lifted, with all its controls in place, by a crane.

convection. A process of heat transfer in a gas or liquid by the circulation of currents from one region to another. It is an important means of energy transfer between a solid surface and a liquid or gas.

The key role of convection in a helical coil heater is the heating of the coil surfaces that are not exposed to radiant energy. These are the coil surfaces that face the outer shell of the heater. Convection heating occurs after the hot combustion gases travel through the center of the coil and then double back into the annular space between the insulation and the coil.

Cor-Ten. A trademark of United Steel Corporation for a high-strength, low alloy steel plate. (See also *Tri-Ten.*)

counterflow drum mixer. A combination counterflow dryer and drum mixer for making HMA. Astec's unique Double Barrel™ drum mixer is an example of counterflow drum mixer where its inner drum functions as a counterflow dryer and its stationary outer shell functions as a mixer. Other types of counterflow drum mixers are produced by other manufacturers.

counterflow dryer. An aggregate dryer in which the aggregate and the hot gas steam flow in opposite directions. Counterflow dryers are inherently more efficient than parallel-flow dryers for making HMA.

CPU. Central Processing Unit. (See *microprocessor.*)

crib. Jargon for shim. (See *shim.*) The term *cribbing* is sometimes used to mean a wall of timbers that confine earth and serve as a retaining wall.

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cycle time. The total time required for a pugmill to make and discharge a batch of HMA. (See *pugmill*.)

cyclone. A cylindrical chamber used to separate coarse dust particles from the gas stream produced during the aggregate drying process. The cyclone is normally used between the dryer and baghouse and drops out the coarse particles before the gas stream enters the filter section of the baghouse.

The cyclone imparts a whirling, spiraling motion to the gas stream. Centrifugal force causes the larger (heavier) particles to move to the outer perimeter of the air mass where they slow down and fall out of the stream.

Two types of cyclones are commonly used: vertical and horizontal. Vertical cyclones are usually free-standing units. Horizontal cyclones are usually an integral part of the baghouse. Knockout boxes are also used to separate dust particles. (See *knockout box*.)

damper. An adjustable louver incorporated in the exhaust stack, right above the fan housing. Most have opposing blades, which open and close to incrementally adjust the flow of exhaust air. The blades are powered by an actuator. Blade movement is controlled automatically as a result of changes in suction at the burner of the dryer.

dB. Abbreviation for decibel.

dead band. Allowable deviation. (See *deviation, process variable, and set point*.)

decibel. A unit used to express relative difference in power or intensity, usually between two acoustic or electric signals. A decibel is equal to ten times the common logarithm of the ratio of the two levels.

deck. A platform that contains a screen used to separate materials. Cold feed systems normally use one or two screen decks. RAP systems normally use only one. Batch towers normally use three-and-one-half. Additional decks can be added if needed.

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Deister. A trademark for widely used screening equipment produced by the Deister Machine Company, Inc. (See *deck*.)

deviation. The difference between process variable and the set point. (See *process variable* and *set point*.)

differential pressure. In a fluid or hydraulic circuit it is the difference in pressure at two points in the circuit. It occurs normally in a fluid circuit when fluid flows through its components. The amount of the differential is related to how much resistance is offered by the component and the resistance of the circuit piping. The higher the resistance the higher the differential pressure.

In a typical hot oil heater there may be a 20 psi differential pressure across the helical coil due to its resistance. Differential pressure may also be referred to as *pressure drop*.

Dinosaur. An Astec trademark for a portable RAP system. The system has equipment to store RAP, screen it and deliver it to the mixer.

direct-fired tank. A type of heated tank used to store asphalt cement. It has a built-in burner and a main fire tube. The fire tube has two return tubes.

The tank may have hot oil scavenger coils that scavenge a moderate amount of heat from the heated asphalt to heat AC piping, a pugmill, an AC bucket, etc. The temperature of the oil in the scavenger coils is sometimes increased by use of a booster heater, which is a standard hot oil heater.

A direct-fired tank has the following features that distinguish it from a Heli-tank: 1. A burner mounted on one end of the tank. 2. Two stacks protruding from the top of the asphalt tank.

diverter chute. A chute used to divert material into a truck before it enters a dryer or drum mixer. This is done so the material can be weighed for calibration of the weigh belt. It also allows bins to be emptied when necessary. The chute is usually actuated by an air cylinder.

Double Barrel. A trademark of Astec Industries for a unique *counterflow drum mixer* (see above) produced exclusively by Astec.

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The mixer gives high-production rates and top-quality mixes at the same time. It produces no visible emissions, even when using up to 50 percent RAP.

The Double Barrel mixer combines the functions of a dryer and a pugmill. It has a drum that rotates inside a stationary outer shell. The interior of the drum serves as a highly efficient counterflow dryer. The outside surface of the drum has mixing paddles affixed to it and functions as the rotating shaft of a large pugmill. The bottom half of the stationary outer shell functions as the pugmill housing. The mixing paddles pass through the materials, stirring and mixing them as they travel along the bottom of the shell.

Thus, the mixing takes place in a zone away from the hot gas stream of the dryer. The low oxygen atmosphere in the mixing zone minimizes oxidation of the mix. Long mixing times of approximately 75 seconds ensures that materials are blended uniformly and consistently.

Virtually none of the drying heat is wasted into the atmosphere. Some of the heat is conducted through the drum walls to material that has reached the mixing zone. Moreover, the stationary shell is covered with three inches of fiberglass insulation to keep heat loss from the mixing zone to a minimum. Flexible end seals minimize air leakage.

dowel pin. A special pin used to pivot trunnion mechanisms, allowing optimum adjustment. (See *trunnion*.)

down stream. (See *up stream*.)

draft. The current of air flowing through a drum dryer and baghouse. (See *baghouse*.)

drag. Jargon for *drag conveyor*.

drag chain. A key part of a drag conveyor.

drag conveyor. A conveyor commonly used in a continuous mix facility to transport hot mix from the drum mixer to storage silos. Small drag conveyors are also used on some baghouses to transport baghouse fines.

A drag conveyor has a chain that runs in a continuous loop. The chain has slats attached to it every few inches. The slats drag or run

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along the steel bottom of the conveyor housing. Each slat drags material along the bottom of the conveyor until it reaches the end of the conveyor where the material is dropped out.

Drag conveyors for hot mix are usually heated by hot oil flowing through jackets built into the bottom of the conveyor housing.

Drag conveyors are sometimes called by other names such as *slat conveyors* and *drag slat conveyors*. Sometimes *drag* is used as a single word to mean *drag conveyor* and should be regarded as jargon.

drag slat conveyor. (See *drag conveyor*)

drum mix plant. A continuous mix plant or facility that uses a drum mixer to make HMA. (Compare *batch facility*.)

drum mixer. A combination drum dryer and mixer for making HMA. (See *counterflow drum mixer* and *parallel flow drum mixer*.)

dry mixing time. (See *mixing time*.)

dryer. A major piece of equipment in a HMA facility used to dry aggregate before it can be mixed with liquid AC. The type of dryer used in modern HMA facilities are drum dryers. Drum mixers usually combine a drum dryer with its mixing components. (See *counterflow drum mixer* and *counterflow dryer*.)

dust. (See *baghouse fines*.)

dwelt time. Usually refers to mixing time. (See *mixing time*.)

economizer. A secondary heat exchanger sometimes used on a hot oil heater at a HMA facility to increase the heating efficiency. Increases of about 4 percent can be expected. It recovers exhaust gas heat, which would otherwise be lost. The recovered heat pre-heats the thermal fluid before it flows through the primary heat exchanger. It is also known as an air-to-oil heater.

The economizer usually consists of a finned serpentine coil in an enclosure mounted at the base of the exhaust stack. The exhaust gasses flow around the coil and heat the fluid flowing through the coil. (Compare with *combustion air pre-heater*.)

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eddy current. The electrical current used to control slippage in the magnetic clutch of a belt feeder. (See *belt feeder*.)

efficiency. A rating often used to denote the performance of major components of a HMA facility. The thermal efficiencies of asphalt heaters and aggregate dryers are components of primary concern. Their efficiencies affect the amount of fuel they use. Fuel costs are a significant part of the overall operating costs of a HMA facility.

The thermal efficiency of a hot oil asphalt heater relates the amount of heat (Btu) the heater produces to the amount of heat actually transferred to the thermal fluid flowing through it. Thus, a heater that is 85 percent efficient uses 85 percent of the heat produced to heat the fluid and wastes 15 percent.

Similarly, the thermal efficiency of an aggregate dryer relates the amount of heat (Btu) the dryer produces to the amount of heat actually transferred to the aggregate flowing through it.

All heat that does not go into the thermal fluid or aggregate is wasted. Consequently, all heat that goes out the exhaust stack is wasted heat. And so is any heat that is lost by air leakage or as the result of poor insulation.

Temperature of the exhaust gas is a good indication of efficiency where most of the heat that is lost goes out the stack. The lower the temperature of the exhaust gas, the higher the efficiency.

Net (LHV) thermal efficiency can be easily calculated using the following formula:

$$E_{th} = [(H_{input} - H_{stack}) / H_{input}] \times 100$$

Where:

E_{th} is percentage thermal efficiency (net)

H_{input} is Heat input Btu (LHV)

H_{stack} Stack loss Btu

emissions. Unwanted substances produced by a HMA facility. The substances may be either gases or particulate. Federal, state, and local environmental codes usually limit the amount of emissions or pollutants that industrial and commercial operations can release into the atmosphere. Accordingly, a HMA facility must have provisions to limit specified emissions produced or released.

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emulsion. Emulsified asphalt. A mixture of asphalt cement, water, and emulsifying agent. Used for surface treatments, penetration macadams, cold asphalt-aggregate mixtures, tack coats, fog seal, and slurry seals.

excess air. Also called excess combustion air. The air remaining after the fuel has been completely burned. Thus, it is the air supplied in addition to the amount required for stoichiometric combustion. (See *primary air* and *secondary air*.)

exhaust stack. Usually a large vertical duct on a baghouse with the baghouse exhaust fan mounted in its base. The duct usually has sampling ports at its upper end where it exhausts into the atmosphere.

fabric. (See *cloth*.)

facility. This term is used within the asphalt industry to mean a site with equipment designed and set up to produce HMA. *Facility* and *plant* mean essentially the same thing. However, the term *facility* is preferred by NAPA.

feeder belt. (See *belt feeder*)

fiberglass. A generic word for a material made of fine glass fibers. Note that *Fiberglas* (capitalized and spelled with one *s*) is not generic but is a registered trademark.

fifth wheel. The coupling on a truck tractor for towing a semitrailer chassis. It couples to a king pin on the gooseneck of the trailer. The fifth wheel is mounted over the rear axles of the tractor and supports the forward end of the trailer.

filler. (See *mineral filler*.)

filter bags. Bags made of aramid fiber cloth or fabric for filtering dust particles from the gases of the aggregate drying process. A baghouse may contain over 1,000 filter bags. (See *baghouse* and *aramid*.)

finer. (See *baghouse fines*.)

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finned pipe. Pipe with fins. Metal fins are often affixed to pipe to significantly increase the heat conducting surface area of the pipe. Fins increase conduction about 300 percent. Fins are commonly made by spiraling a long strip of metal around the pipe and welding one of its two long edges to the pipe. The fins may be either solid or serrated. A serrated fin is made by making numerous cuts along one edge of the fin. The serrations increase efficiency by increasing the turbulence of liquid flowing around the fin. It also increases its surface area slightly.

fire tube. In a direct-fired tank it is the heating tube into which the burner fires. The tube conducts heat produced by the burner to the asphalt cement surrounding the outer surfaces of the tube. (See *direct-fired tank*.)

Fireye. Brand name for a burner flame monitor system commonly used on hot oil heaters. The system detects whether there is a flame present in the firing chamber. It uses a microprocessor to manage the burner controls and provide proper burner sequencing, ignition, and flame monitoring protection on automatically ignited oil, gas and combination fuel burners. It also provides operating status and lockout information in the event of a safety shutdown.

first out annunciator. An electrical signaling device used to indicate the source of a problem or abnormal condition in an electrical control system. Annunciators are frequently used in the burner management systems of hot oil heaters and aggregate dryers. When a problem occurs that causes the burner to shut down, the annunciator identifies the limit switch that tripped *first*, setting off a chain reaction that caused the shutdown.

Signal lights are sometimes used as an alternate to an annunciator. The lights come on to denote all switches that have tripped. However, they are less effective because several may come on to denote *all* switches affected by the shutdown. This leaves no clue as to which one actually tripped *first* and triggered the shutdown.

flexible hose. A type of flexible metal pipe commonly used in liquid asphalt and hot oil lines in HMA facilities. A short piece of flexible hose is commonly used at connections of non-flexible lines to eliminate strain. They are used at connections of pumps and at

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joints of jacketed asphalt lines. Flexible hose used at HMA plants usually has a metal bellows covered by a wire braiding for extra strength.

flights. Metal blades that transport materials along the inside of the dryer drum as it rotates. Some shower the material through the heated gas stream.

Several types are used. Typical ones are known as screw flights, showering (cup) flights, combustion or T-flights, discharge flights, and reversing screw flights.

Some of the showering flights of new drums include bolt-on parts known as kicker flights. They are extra flights that enhance the effect of the showering flights. The amount of showering needed is affected by the type of materials being dried and its moisture content. So, if necessary, some of the kicker flights can easily be removed when the unit is set up at the plant site.

flop gate. A gate commonly used at entry and exit chutes on dryers and mixers to minimize the entry of outside air into the drum. The gate is pivoted and is free to swing or flop. The force of material flowing through the gate causes it to open wide enough for the material to pass. Gates at entry chutes are metal and have weights to help keep them closed. Gates at exit chutes are rubber reinforced with metal.

front-end loader. A mobile vehicle equipped with a bucket shovel. Its main use in a HMA facility is for scooping up material from stock piles and loading it into cold feed bins.

fuel meter. A device that records the amount of fuel used in a given period at a HMA facility. It records the amount used since the last time the meter was reset. When used in the main fuel supply line at a HMA plant it records the total amount of fuel used at the facility. A separate fuel meter is recommended for hot oil heaters to separate its usage from the dryer and other components. This allows tracking its fuel usage to determine the cost benefits of upgrading to a heater with higher efficiency.

fuel oil. One of several types of fuels used to operate heating equipment in a HMA facility. Fuel oil grades 1, 2, and 4 can be

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used. Burners can be equipped to operate on these as well as LP and natural gas. By addition of special equipment, heavy oil, and waste oils can be used.

fuel tank. A container for storing fuel oil used to operate a HMA facility.

gas. A state of matter which is neither solid or liquid. Matter in a gaseous state is highly compressible. It has relatively low density and viscosity and undergoes relatively great expansion and contraction with changes in pressure and temperature.

gas stream. The flow of hot gasses produced by the aggregate drying process. The gas stream flows through the dryer and baghouse carrying combustion gases from the burner plus dust and steam from the drying process. The baghouse exhaust fan pulls in combustion air for the burner of the aggregate dryer and causes the gases to flow.

gate valve. A type of control valve commonly used in hydraulic and pneumatic circuits to shut off flow. A gate, similar to a guillotine, moves to close passage through the valve as it is actuated. Most gate valves used at HMA plants are manually operated, requiring multiple turns of a wheel on a threaded shaft.

Gate valves are sometimes used in piping of hot oil heaters and asphalt storage tanks. They can be used in lines for hot oil, asphalt, fuel oil, or gas. However, they are not recommended for use in lines carrying liquid that normally contains foreign matter or debris that can accumulate in their grooved seats and prevent complete shut off. When used for asphalt, the valve usually has a hot oil jacket.

Pneumatic or hydraulic actuating cylinders cannot be used to operate a gate valve.

gear pump. A type of positive displacement pump widely used in the HMA industry. It displaces a liquid by reducing the volume between its parts as they rotate. If the displaced liquid encounters resistance that equals or exceeds the force created by the pump, the pump normally continues to displace the liquid, increasing its pressure until it opens a relief valve to bypass the liquid back into the supply line. Compare *centrifugal pump*.

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glad hands. Quick disconnect air hose connectors on a truck tractor. The connectors facilitate connecting air brake lines from the tractor to a trailer.

globe valve. A type of control valve commonly used in hydraulic and pneumatic circuits to regulate flow. It has a globe-shaped plug that moves to restrict the flow as its spindle is actuated. Most globe valves used at HMA plants are manually operated, requiring multiple turns of a wheel on a threaded shaft. A variety of configurations and plug shapes are available. Some plugs are conical-shaped. Others are parabolic-shaped.

Globe valves are used in piping for hot oil heaters. They can be used in lines for thermal fluid (hot oil), fuel oil or gas. They are not recommended for piping carrying liquid asphalt. Pneumatic or hydraulic actuating cylinders cannot be used to operate a globe valve.

gooseneck. The forward end of a semitrailer that steps up from the main chassis. It has a tow pin that extends down vertically and connects to the fifth wheel of a tractor.

gpm. Abbreviation for *gallons per minute*.

graphics panel. An optional panel that graphically pictures the major components of a HMA facility and the status or operating state of key controls. Although much of the same information can be determined from the standard control panels, a graphics panel is faster and easier to comprehend.

grated. A surface (usually for walking) that incorporates a steel grating. (See *grating*.)

grating. The floor commonly used for work platforms on HMA equipment. It is usually a grill or network of steel bars that provides a non-slippery walking surface and does not collect water and dust.

gravity chute. A chute that feeds material by gravity. Entry and exit chutes of dryers are usually gravity chutes. However, slinger feeders are sometimes used instead of gravity entry chutes. (See *slinger feeder*.)

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gravity take-up. A mechanism for taking up slack in a conveyor belt to control its tension. The mechanism uses a weight suspended from disk pulleys.

This type of take-up is used on long conveyors and on conveyors that incorporate weigh belts. Belt tension on other conveyors is controlled by adjusting the tail pulley.

The gravity take-up mechanism has advantages over tail pulley adjustment. The gravity take-up mechanism has a wider range of adjustment and automatically maintains tension despite belt stretch.

grizzly. (See *bar grizzly*.)

GTR. Ground tire rubber. Sometimes mixed with virgin asphalt cement to make a modified asphalt.

hammermill. A type of impact crusher. (See *impact crusher*.)

hanger bearing. One type of bearing used in screw conveyors to support the screw shaft. Such bearings are suspended on hanging brackets, which are attached to the screw housing.

Hauck. A trademark of Hauck Manufacturing Co., a manufacturer of burners used extensively in HMA equipment.

head pressure. The pressure at the outlet of a pump. It is the pressure that produces the flow rate required by the circuit. Head pressure is expressed either as feet of head or psi. Compare with *NPSH*.

heaped. A term used in connection with the capacity of a bin (*heaped capacity*) to mean its maximum capacity. The bin is filled to its top edges and, near its center, heaped higher than the edges. (Compare *struck*.)

heat conductance. Also called *thermal conductance*. A measure of the ability of a material to *conduct* heat flow. It is usually designated by the letter “**k**,” which denotes the number of Btu per square foot, per hour, per degree F, for a stated thickness, usually either one inch or one foot. For example, one square foot of fiberglass one inch thick conducts 0.30 Btu per hour for every degree of tempera-

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ture difference. Dividing the **k** value by six gives 0.05, the conductance when the same material is 6 inches thick. (See also **R-value**.)

Heatec. A company that specializes in designing and manufacturing heating equipment for the asphalt industry and for other industrial applications, such as chemical plants, petroleum plants, food processing plants, arctic housing, etc. Heatec is a subsidiary of Astec Industries, Inc.

heater. Heaters are used in a HMA facility to heat asphalt cement for use in HMA and to maintain the heat in HMA during transfer and storage. (See *direct-fired heater*, *helical coil heater*, and *Helitank*.)

heat exchanger. A device that either heats or cools materials flowing through it. Heat exchangers are commonly employed in asphalt storage tanks and hot oil heaters used at HMA plants. The type of heat exchanger used in this equipment is usually either a helical coil, serpentine coil or jacketed fire box.

heat loss. The difference between the amount of heat energy produced and that used. It is heat produced without getting any benefit from it. Thus, it is wasted energy, which can be costly. Because of the need to avoid wasted cost and to conserve our resources every effort should be made to avoid heat loss. This is especially true at a HMA facility because of the large amount of heat energy needed to produce hot mix. Heat losses can be minimized by use of insulation, a very cost effective solution.

heat transfer. The passage of heat from one medium to another by means of conduction, convection or radiation.

heavy fuel preheater. A heater used to pre-heat heavy fuel oil so it can be burned by a fuel oil burner. Preheaters are typically used to heat No. 5 or No. 6 fuel oils for aggregate dryers. The pre-heating lowers the viscosity of the oil so it can be atomized by the burner.

A preheater is usually connected in the fuel supply line between the fuel tank and dryer. Or, it can be mounted inside the fuel tank. It may be used to pre-heat the fuel flowing directly to the burner when a single pass through the heater raises its temperature

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adequately for atomization. The fuel may be recirculated to the fuel tank if additional heating is needed.

The preheater usually consists of a shell-and-tube heat exchanger with a capacity of approximately 80–120 gallons. The fuel oil is heated as it passes through the shell surrounding the tubes. The tubes are heated by thermal fluid (hot oil) from a hot oil heater as it circulates through the tubes.

helical coil. A pipe formed into a spiral or helix. A helical coil is the primary heat exchanger in a helical coil heater. See *helical coil heater*. Compare with *serpentine coil*.

helical coil heater. A type of hot oil heater used to heat heat-transfer oil in a HMA facility. It has an insulated cylinder that houses a helical coil. A burner mounts on the end of the cylinder and fires through the center axis of the coil. Heat-transfer oil is pumped through the hot coil to heat the oil. The heater has an expansion tank.

helicoid. Shown in dictionaries as a generic term for objects that have a spiral or helical shape. Thus, the term applies to the screw of a screw auger, to the threads of ordinary screws, etc. The term should not be confused with the trademark Helicoid (spelled with a capital **H**), used for gauges produced by Bristol-Babcock, Helicoid Instruments.

Heli-coil. A trademark for a wire thread insert produced by Heli-Coil, Emhart Fastening Teknologies, a Black & Decker Company. The term should not be confused with *helical coil*, a generic term used in connection with helical coil heaters. (See *helical coil heater*.)

Heli-tank. A trademark of Heatec for a type of heated tank used to store asphalt cement. The Heli-tank is usually portable, mounted on a chassis with suspension and wheels. It is virtually the same as a coiled tank except it has a hot oil heater mounted on the goose neck of the chassis. The hot oil heater can heat additional coiled tanks. Heli-tanks are sometimes called a Heli-Pack.

A Heli-tank has the following features that distinguish it from a direct-fired tank: 1. A hot oil heater mounted on one end of the tank. 2. No stacks protruding from the top of the asphalt tank.

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HHV. High heating value. The *gross* amount of heat (Btu) produced by a fuel. No. 2 fuel oil, which is widely used in the HMA industry, has a HHV of approximately 140,000 Btu per gallon. Natural gas has a HHV of approximately 1,040 Btu per cubic foot. (See also *LHV*.)

HMA. Abbreviation for *hot mix asphalt*.

hopper. A sloped or funnel shaped container in which materials are collected to facilitate transferring them to another location. The bottom of a baghouse is made into a hopper for collecting dust that is subsequently carried out of the hopper by a screw conveyor. Bins and silos may be regarded as hoppers although they are not usually called by that term.

horizontal asphalt tank. A cylindrical tank used at a HMA facility to heat and store asphalt cement. The tank is installed so that its long axis is horizontal and it occupies a ground area equal to its diameter times its length. They are easily equipped with wheels and suspension for highway travel. See *vertical asphalt tank*.

horizontal cyclone. (See *cyclone*)

hot bin. One of several bins in the top of a batch tower. These bins store the hot dry aggregate from the dryer after it is screened and before it is mixed with AC.

hot elevator. Also called a *bucket elevator*. It is a *vertical* conveyor normally used in a batch plant to transport hot aggregate to the batch tower. One is sometimes used with a continuous mix facility instead of a drag conveyor.

The hot elevator has a chain that runs in a continuous loop. The chain has buckets attached to it every 12 to 18 inches. The buckets are loaded at the bottom of the elevator and travel vertically within the elevator housing. The buckets empty as they reach the top end of the conveyor and start down.

Although hot elevators and drag conveyors can both transport hot material, there is an important difference between them. Hot elevators usually operate vertically, although they are sometimes inclined slightly. They require very little space. They are not

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heated. Drag conveyors are normally inclined, require more space, and are usually heated.

hot mix. Hot mix asphalt.

hot mix asphalt (HMA). Road paving material produced by mixing hot dry aggregate and liquid asphalt cement. Basic types of HMA are dense-graded and open-graded. There are sub-types within the basic types.

The mixture is made with the ingredients heated to about 300 degrees F, which is the temperature normally used to dry the aggregate. The liquid asphalt cement will adhere to the aggregate only if it is dry. The mix may also include dust or fines from the aggregate, ground rubber, and additives fillers, such as lime. The mixture is maintained close to 300 degrees until it is applied to the road.

HMA is called by numerous other names, such as asphalt concrete, asphaltic concrete, asphalt cement concrete, asphalt mix(ture), asphalt paving mix(ture), bituminous concrete, bituminous mix(ture), bituminous paving mix(ture), etc.

hot oil heater. A heater used to heat oil that is piped to various components of a HMA facility to keep materials in them hot. Hot oil is usually piped to asphalt coiled tanks, drag conveyors, hot elevators, surge bins, and HMA storage silos. The type of hot oil heater used is usually a helical coil heater. (See *helical coil heater*.)

hot oil manifold. A component of a hot oil heater for distributing hot oil. It is a pipe chamber that has multiple connections for pumps and hot oil lines that go to various components of a HMA plant.

idler. A non-driven wheel, roller or sprocket, used mainly to support belts and chain. (Compare with *pulley*.)

impact crusher. A machine commonly used to crush material in stone quarries or metallic mines. They are also used in recycling asphalt or concrete.

One type of crusher is known as a horizontal shaft impactor (HSI). It has long bars, known as blow bars or hammers, fixed on a

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rotor so they cannot rebound. The bars strike the material breaking it and throwing it against hinged aprons which cause further breakage.

Another type of impact crusher is known as a hammermill. It is used in HMA facilities to reduce milled RAP to the proper feed size for inclusion in HMA. It has rows of swinging hammers that are free to rebound when they impact the material. The hammers break the pieces of material and hurl the fragments against a breaker plate reducing their size even further.

The hammermill has a screen bar in its bottom section that allows smaller material to pass, but retains oversized material until additional blows reduce its size as needed to pass.

impactor. (See *impact crusher*.)

impeller. A rotating device used to force fluid in a desired direction under pressure. They are used in centrifugal pumps. They are also used in asphalt tanks to keep polymers in the asphalt in suspension.

inclined conveyor. A belt conveyor used mainly in a cold feed system to carry aggregate from the scalping screen to a drum mixer or dryer.

industrial grade. Sometimes used to designate a special grade of equipment or components. This grade of equipment is designed to perform in environments or under conditions less favorable than regular or standard grades of the equipment.

insulation. A substance that reduces heat loss from heated materials used in HMA facilities. Four types of insulation are commonly used: 1) ceramic fiber blanket; 2) fiberglass blanket; 3) mineral wool blanket; and 4) molded foamglass. Refractory is also a type of insulation. It is used mainly in firing chambers and serves a dual purpose. It retain heats to increase burner efficiency and it reduces heat loss.

jacketed asphalt line. An asphalt line that has an outer jacket through which hot oil flows. The hot oil heats the asphalt cement in the line to maintain its temperature as it is used to make HMA and to keep it from solidifying when the plant is idle.

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jacketed asphalt valve. An asphalt valve that has an outer jacket through which hot oil flows. The hot oil keeps the asphalt cement from solidifying when the plant is idle.

jacketed firebox heater. A type of hot oil heater used to heat thermal fluid in a HMA facility. The thermal fluid flows through channels that surround a jacketed firebox or combustion chamber and is heated by radiant energy. The fluid also flows through a shell-and-tube heat exchanger and is heated by convection.

jogged joint. A jogged joint is a welded joint where one of two parts being joined is jogged (stepped) allowing the other part to fit into the jogged area. As a result, one side of the joint is smooth without a protruding surface. The radial joints of Astec silos have joints jogged to the outside to reduce wear on the inside of the joints.

king pin. A pin on the gooseneck of a semitrailer used to connect the trailer to the fifth wheel of a truck tractor for towing. (See *fifth wheel*.)

knockout box. A chamber on a baghouse used to separate coarse dust particles from the gas stream produced during the aggregate drying process. It may be used either in lieu of a cyclone or in addition to a cyclone. When used in lieu of a cyclone, the chamber is usually larger than when used with a cyclone.

A knockout box works on a different principle than a cyclone and is less efficient. The velocity of the dust-laden gas stream decreases upon entering a knockout box because the cross sectional area of the box is greater than that of the duct entering the box. The decreased velocity causes larger (heavier) dust particles to drop out of the gas stream and fall to the bottom of the box. Thus, the larger dust particles do not enter the filter section of the baghouse. This increases the effectiveness and efficiency of the filter bags. (See *cyclone*.)

landing gear. Legs installed at the gooseneck end of a portable unit and used to temporarily support the unit upon separation from the tractor. They are manually raised and lowered with a hand crank.

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leakage air. Air that leaks into the drying system through holes in ductwork, inlet chutes, discharge chutes, etc. It is unwanted and should be minimized or eliminated, as much as possible.

legs. Upright supports for a major component in a HMA facility. Legs are made from structural steel and go between structural members and the foundations, which may be either structural steel or concrete. The legs of portable units are adjustable and can be raised and lowered. This facilitates moving the plant and makes it possible to set up the unit on unlevel ground without the need for shims.

legs-to-grade. Legs long enough to reach a grade while maintaining the unit they support at a specified height above the grade. Some components may need legs longer than those normally furnished.

If the unit cannot be shipped with the longer legs in place because of shipping limitations, extensions are furnished. These either bolt or weld onto the normal legs. The longer legs are commonly used to eliminate the need for concrete pillars.

level switch. A switch used in a tank to activate controls that keep the tank from overflowing. The switch is usually activated by a float supported by the liquid in the tank. Level switches are used in asphalt storage tanks, fuel tanks and the expansion tanks of hot oil heaters. Level switches in asphalt and fuel tanks shut off the unloading pump when activated. Level switches in expansion tanks shut off the heater when activated. Compare *bin level indicator*.

LHV. Low heating value. The *net* or useable amount of heat (Btu) produced by a fuel. For example, No. 2 fuel oil has a LHV of approximately 132,300 Btu per gallon. One cubic foot of natural gas has a LVH of approximately 905 Btu. The difference between HHV and LHV is due to hydrogen in the fuel, which is normally lost as water vapor. Both values are sometimes used in calculating the amount of fuel required for heating asphalt and drying aggregate. However, it is usually more appropriate to use LHV.

light oils (also known as light ends). Volatile organic compounds that may separate from liquid AC during production of HMA. When light oils are vaporized they may produce unwanted

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emissions. Varying amounts of light oils remain in asphalt cement when it is produced by refining crude oil. This is because the properties of crude oil from different sources vary widely.

lime silo. A silo for storing lime used as an ingredient of HMA.

limit switch. A electrical switch that is activated when certain components of a HMA plant reach preset limits. Limit switches are used for a wide variety of purposes. They can be activated by pressure, temperature, or by moving parts.

liquid AC. (See *liquid asphalt cement*.)

liquid asphalt cement. Asphalt cement that is heated to a liquid state to make it suitable for mixing with aggregate to make HMA. At ambient temperatures, asphalt cement is a semisolid. (See *asphalt cement*.)

live zone. The mixing capacity of a pugmill. It is the cubic volume of the zone below a line extending across the top of the paddle arc, minus the volume occupied by the mixing shafts, arms, tips and liners.

load cell. A sensing device that modifies an electrical signal in proportion to the amount of weight imposed on it. Thus, when a load is applied to the cell, the resulting electrical signal can be calibrated and displayed to indicate the amount of weight bearing directly on the cell.

lockout. A safety provision whereby electrical controls can be locked to keep anyone from turning on electrical power when doing so could endanger anyone working on the equipment affected. An entirely different type of lockout may be incorporated into electronic controls to prevent a circuit from being activated unless certain conditions are met.

loop pump. Also called a *side* or *auxiliary* pump. A pump used to circulate thermal fluid (hot oil) in a secondary or auxiliary circuit for heating components other than those heated by the main circuit.

lump breaker. A machine widely used in HMA facilities to break up loosely compacted lumps of RAP. Unlike an impact crusher it is not capable of breaking rock or hard asphalt.

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The typical lump breaker has two 18-inch diameter perforated drums that break up the material as it is squeezed between them. Steel bits on the outer surfaces of the drums help feed and break the material. Each roll is turned by a separate 10-hp motor and a shaft-mounted reducer.

macadam. An early paving material consisting of compacted broken stone. Now, it is usually bound with tar or asphalt. The term is often used synonymously with hot mix asphalt, but is a somewhat antiquated term. [After John Loudon McAdam (1756-1836), Scottish civil engineer.]

MAD. Multiplexed Analog-to-Digital board. An electronic board used in the Astec PM-96 computer to convert analog signals from load cells, speed sensors, etc. to digital signals for use by the CPU. The signals from these sources are multiplexed. This means that discrete samples of the individual signals are passed one-at-a-time through the analog-to-digital converter and then to the computer. The computer keeps signals from each source separated as it stores and processes them.

magnetic clutch. An electro-magnetically controlled clutch with variable slippage used in the drive system of a belt feeder. (See *belt feeder*.)

manhole. An opening through which a person can enter a storage tank or silo at an HMA facility. Virtually all manholes at HMA plants have latched or bolted covers. Sometimes called *hatchway* and *manway*.

manifold. A pipe or header in a hot oil system for distributing hot oil from its source to pipes of various circuits.

mass flow meter. An electronic measuring system used as an asphalt metering system at a HMA facility. The system indicates the asphalt flow rate and the total volume since the system was last reset to zero. Mass flow meters have a high degree of accuracy and virtually no moving parts. However, they are significantly more expensive than other systems used for asphalt metering. The system has a electronic sensor and transmitter that measure flow rate, density, pressure, viscosity and temperature of the asphalt. It

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compensates for temperature variations in the material. (See *asphalt metering system*.)

mesh numbers. Size designations for wire mesh sieves used to analyze aggregate particles. Two systems are used to designate size.

One system designates particles smaller than 1/4-inch and uses numbers ranging from 4 to 400. These numbers indicate the number of *openings per linear inch* of the sieve.

The other system designates particles 1/4-inch and larger and uses either inches or millimeters to directly indicate the *clear space between the wires* of the mesh.

Sieves typically used for sieve analysis and gradation specifications for HMA are shown in the table below. On sieves with numbered designations, the sieve clear opening will change if the wire diameters are changed from those shown.

Typical Sieve Sizes Used For HMA		
Sieve Designation (inches)	Nominal Wire Diameter (inches)	Sieve Clear Opening (inches)
2 inches	0.1988	2.0
1-1/2 inches	0.1807	1.5
1 inch	0.1496	1.0
3/4-inch	0.1299	0.75
1/2-inch	0.1051	0.5
3/8-inch	0.0894	0.375
No. 4	0.0606	0.187
No. 8	0.0394	0.0937
No. 16	0.0256	0.0469
No. 30	0.0154	0.234
No. 50	0.0085	0.0117
No. 100	0.0043	0.0059
No. 200	0.0021	0.0029

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microprocessor. A small, but vital part of computer systems that control HMA equipment. It is known as the central processing unit (CPU). It is a single chip that contains millions of transistors in an integrated circuit package. (See *PM-96*.)

milling machine. Also called a cold planer. (See *cold planer*.)

mineral. A natural, homogeneous, inorganic, solid substance used as the main ingredient of HMA. A wide variety of minerals can be used in HMA, but the main ones used are sand and stone.

The materials available vary widely according to geographical location. The following materials are used in HMA in various parts of the world:

soft limestone	quartzite
limestone	trap rock
dolomite	gravel
sandstone	granite gravel
granite	slag

mineral filler. A filler material used as an ingredient for HMA. It is usually any mineral that will pass a 200 mesh screen.

minus 200 mesh. (Also written as – 200 mesh.) An expression used frequently to designate the sizes of the particles in baghouse fines. It refers to the dust particles that can pass through a sieve with 200 wires per linear inch.

The size of these particles will be smaller than 0.0029 inch (75 microns), depending upon the size of the wires used in the sieve. Thus, the fines will include many sizes of particles ranging from 0.0029 inch (75 microns) down to 0.0015 inch (37 microns) or less.

Baghouse fines of this size are, for the most part, those that are captured by the filter bags. After they are collected some may be added to the asphalt mix. Otherwise, they will be wasted.

Incidentally, for size comparisons a human hair is approximately 100 microns in diameter. Cigarette smoke has 0.3 micron particles.

mixer. A key component of an asphalt facility for mixing the ingredients of HMA. Most continuous mix facilities use a *drum mixer*. Some use a *coater*. Batch facilities use a *pugmill*.

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mixing chamber. (See mixing zone.)

mixing paddles. Parts within a drum mixer or pugmill for blending HMA. Each paddle has a shank and tip.

mixing time. The total amount of time that ingredients of HMA are mixed with each other while in the mixing zone. Typical mixing times are 45 to 60 seconds for a Double Barrel mixer, and about 33 seconds for a pugmill in a batch plant. A portion of the mixing time (dry mixing time) takes place before liquid AC is added. The remainder of the mixing time (wet mixing time) is with the liquid AC included.

mixing tips. Cast metal blades for mixing ingredients of HMA. Mixing tips are used in drum mixers, pugmills and coaters. The tips attach to nodular iron shanks and can be replaced when worn out. The Double Barrel drum mixer uses three lengths of mixing or blending tips attached at different angles to their shanks.

mixing zone. The area within a drum mixer, pugmill or coater where the ingredients of HMA are mixed with each other.

modem. A communications device that enables a computer to transmit information over a standard telephone line. One is furnished with the PM-96A computer and can be used to connect the computer via phone line to diagnostic equipment at the Astec factory. This enables Astec service personnel to trouble-shoot equipment in the field just as if they were at the field site.

modified asphalt. Asphalt cement that has been modified by the addition of another material, usually a polymer such as SBS. The addition of certain polymers to asphalt cement improves the performance of HMA made with it.

modular. A type of construction used in Astec's relocatable facility trademarked M-Pack. Major units of the plant come complete with built-in steel foundations and bulkheads. Related components and parts are mounted, pre-wired, and pre-piped at the factory. Plug-in rubber cables are furnished so the units can be easily interconnected when they are in place.

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modulating burner. A burner that can be fired at variable rates. A modulating burner can be fired at a rate that closely matches the heat demand. This conserves fuel, reduces temperature overshooting, and eliminates constant on-off recycling.

Module 208. An electronic circuit board used in the PM-96 computer to isolate and condition frequency-coded signals from tachometers used on belt feeders and conveyor belts.

Module 209. An electronic circuit board used in the PM-96 computer to isolate and condition analog signals from load cells, such as those used on belt scales.

molecular plastic. A special polyethylene material sometimes used as a liner for cold feed bins to enhance the flow of material from the bin. The material has very little sliding resistance and has good wear resistance.

motherboard. The main circuit board containing the primary components of a computer system.

motor control panel. One of several control panels used to control equipment of a HMA facility. This panel is usually installed in a console in the control house.

M-Pack. A trademark of Astec Industries for a relocatable asphalt facility produced exclusively by Astec.

NAPA. National Asphalt Paving Association. An association of asphalt paving contractors, headquartered in Landham, Maryland.

neat asphalt. Unmodified, virgin asphalt cement.

Ni-Hard. A trademark of The International Nickel Company, Inc. for an abrasion-resistant cast steel of very high hardness. Castings made of this steel are used extensively to line components of an asphalt plant to reduce wear.

nitrogen blanket. A layer of nitrogen gas covering the hot oil in an expansion tank of a hot oil heater to minimize oxidation of the oil. Reducing oxidation of the oil can significantly prolong its life. This, in turn, reduces operating costs.

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no-flow switch. A switch that controls a circuit with a warning light to signal when there is no flow of material on a belt conveyor, on a feeder belt, or in a screw conveyor.

noise control. Any method of either reducing noise levels or limiting its propagation beyond specific boundaries or both. A number of methods are used to control noise at HMA plants. Some components are enclosed in a housing that has baffles or sound absorption material or both. Barriers, walls and dirt berms may be constructed to block or to redirect sound. Plant equipment that produces unwanted noise may be located so as to rely on natural attenuation that occurs as the noise travels to controlled zones.

noise ordinances. Federal, state and local laws that set limits on the level of noise a facility may generate at neighboring properties.

noise pollution. Noise that may adversely affect human health. There is growing concern in many parts of the world about noise pollution. Consequently, local, state and federal governments are enacting regulations to limit noise pollution from all kinds of industrial activity, including HMA plants.

Nomex. (See *aramid*.)

no-rotation switch. A switch that controls a circuit to signal when a screw conveyor, drag conveyor, hot elevator, or traverse conveyor is not operating.

No_x. Nitrogen oxides. A class of nitrogen bearing gases. Such gases are primary products of combustion and a known factor in the formation of smog and acid rain. They are subject to strict regulation.

NPSH. Net positive suction head. The static pressure exerted by a liquid at the inlet of a pump. It is created by the pressure of liquid that is piped to the inlet from a container or tank. In an open container the pressure is related to the density and height of the liquid level above the pump. Additional pressure is exerted when the container is closed and pressurized.

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Pump manufacturers publish data specifying the minimum NPSH recommended for their pumps. Pumps operated with inlet pressures lower than recommended may be damaged by cavitation.

Adequate NPSH is governed mainly by the design of the fluid system. However, inadequate NPSH may result from abnormal operating conditions, such as low fluid level or an increase in fluid viscosity. (See *cavitation*.)

O₂ trim system. A system that regulates the oxygen content of the flue gases of a heater or dryer. It samples the flue gases for the amount of oxygen it contains and, if necessary, adjusts the burner mixture control to produce an oxygen content within prescribed limits. This causes the heater or dryer to operate more efficiently and minimizes flue gas pollutants.

overloads. Jargon for thermal circuit breakers, especially those in a motor circuit. (See *starter*.)

oxidation. A chemical reaction of asphalt cement with oxygen. Oxidation causes the asphalt in HMA to become harder. Producers of HMA are concerned with oxidation of asphalt cement at four places: in the liquid handling system, in the HMA mixing process, in surge bins or storage silos, and on the roadway.

The rate of oxidation increases as its temperature is raised and as exposure to oxygen is increased. Oxidation doubles for every 25-degree F increase in temperature. For example, mix at 350 degrees oxidizes eight times faster than mix at 275 degrees.

Oxidation can be minimized by heating HMA only as high as needed for mixing and by limiting its exposure to oxygen. Silos used to store HMA should be sealed to prevent atmospheric oxygen from coming into contact with the mix.

On the roadway, oxidation is very slow due to the low temperature and tight surface. When the roadway is cracked, oxidation increases. Therefore, recycled asphalt is oxidized or hardened asphalt.

parallel-flow drum mixer. A combination parallel-flow dryer and drum mixer for making HMA. They were popular a number of years ago, but are rarely built now because they are not as efficient as counterflow drum mixers.

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parallel-flow dryer. An aggregate dryer in which the aggregate and the hot gas steam flow in the same direction. Counterflow dryers are inherently more efficient than parallel-flow dryers for making HMA. However, a parallel-flow dryer is well suited to soil remediation applications.

particulate. Very small solids that are components of dust, smoke, etc. Particulate matter smaller than 10 microns is regarded as a health hazard and is subject to strict regulation.

paving. Pavement. A hard, smooth surface, especially the surface of roads traveled by the public. The most common pavement materials used in modern roads are HMA and concrete. Concrete roads that need repair are often re-paved with HMA.

peep sight. A glass window in a firing chamber of a heater or dryer that allows one to observe the burner flame. Observing the burner flame can provide a lot of useful information about burner performance. For example, the flame pattern indicates if the burner is properly adjusted. And its color indicates whether the air-to-fuel ratio is optimum.

Performance-Graded asphalt. An asphalt binder designed to produce HMA that meets certain performance standards. Designations for performance-graded asphalt binders are prefixed with **PG**. Each grade designation also includes two sets of numbers that denote a temperature range. This is a range of climate temperatures to which the road may be exposed and still be expected to give superior performance. The PG numbers do not indicate viscosity as in conventional liquid asphalt designations.

Consider, for example, the binder designated **PG 58-46**. The first set of numbers 58 refers to the high temperature in degrees C. The second set -46 (minus 46) refers to the low temperature in degrees C. Thus, this binder should perform well in climates where temperatures range from plus 58 to minus 46 degrees C (plus 136 to minus 51 degrees F).

The points where the temperatures are measured and the average duration of time that the temperatures are sustained are detailed in PG specifications.

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Note that both modified asphalts and conventional, unmodified virgin asphalts (commonly known as *neat* asphalts) are assigned PG designations. The PG designations of the unmodified asphalts reveal that they perform well in a more limited range of climatic temperatures than modified asphalts.

A rule of thumb is sometimes used to indicate whether an asphalt incorporates modifiers. Just add the two sets of numbers of any PG designation. (Disregard the minus sign.) If the sum is 92 or greater, that asphalt probably includes modifiers.

PG. Performance Graded. A prefix followed by other numbers that designate an asphalt binder designed to meet certain performance standards. (See *Performance-Graded Asphalt*.)

plant. (See *facility*)

plate foundation. (See *steel foundation*.)

PLC. Programmable Logic Controller. A small electronic processor that can be programmed to automate controls. It has a wide variety of applications. PLCs can be used to automate production of hot mix at HMA plants or virtually any portion of the process. They can also be used to automate a polymer blending process. PLCs provide an economical alternate to a conventional desktop computer system, especially for processes where such a computer is not warranted.

PLCs have modular construction allowing the addition of modules to suit the application. Various modules provide a wide selection in the number of inputs and outputs and whether they are analog or digital.

Each PLC must be programmed for its application. It is usually programmed by a systems engineer and has no provisions for program changes by operators in the field. However, a systems engineer can alter old programs and send new software to users in the field where operators can implement the new program.

plug valve. A type of control valve commonly used in hydraulic and pneumatic circuits at HMA facilities. Two-way versions of the valve are used to either shut off or regulate flow. Three-way

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versions are often used to switch flow from one circuit to another. All use a slotted cylindrical plug that rotates 90 degrees to control the flow.

Plug valves are used in piping of hot oil heaters and asphalt storage tanks. They can be used in lines for hot oil, asphalt, or fuel oil. They are not normally used for gas. When used for asphalt, the valve usually has a hot oil jacket.

An actuator, such as a pneumatic cylinder, can be used to operate the valve through its 90 degree stroke.

PMAC. Polymer-modified asphalt cement. Asphalt cement that has been modified by the addition of a polymer, such as SBS or ground tire rubber.

PM-96. Astec's model designation for the Process Mate computer used to automate continuous HMA facilities. The latest version (PM-96A) incorporates an IBM-compatible desktop computer, color monitor and mouse.

The PM-96A control system automates blending of the mix. It automatically blends virgin aggregate, liquid AC, RAP, and additives, such as lime and anti-strip agents. Blending is based on material flow rates measured by the aggregate weigh scale.

The desktop computer uses Astec software which runs under Microsoft Windows, an extremely popular computer operating system. Computer controlled functions are backed up by manual backup units (MBUs).

The system produces and stores delivery ticket data in a format that can be copied onto a floppy disk and used with other programs.

The computer uses either metric units or U.S. units. It uses any of eight languages: English, German, French, Danish, Hungarian, Turkish, Spanish or Swedish. As an option the computer can use languages other than the eight named.

polymer. Any of numerous natural and synthetic compounds of usually high molecular weight consisting of up to millions of repeated linked units, each a relatively light and simple molecule.

When polymer is mixed with asphalt cement the mixture is known as PMAC or polymer modified asphalt cement. Rubber and plastic are polymers commonly used to produce modified asphalt.

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Rubber is an elastomer and includes natural latex, synthetic latex, block copolymer, and reclaimed rubber. Examples are natural rubber, styrene-butadiene-rubber (SBR), styrene-butadiene-styrene (SBS) and recycled tires.

Plastic polymers include polyethylene, polypropylene, ethyl-vinyl-acetate (EVA), and polyvinyl chloride (PVC).

portable asphalt facility. A facility that has its major components built onto one or more chassis equipped with wheels and some form of suspension system. Each chassis can be transported from one location to another over public highways by a conventional fifth-wheel tractor.

Cranes may not be required for erection. Each major component is prewired. At the plant site the components interconnect with rubber jacketed electrical cables furnished with the equipment.

Astec produces a number of portable plants including the Six Pack facility, which is the most popular portable plant in the United States. Astec 1-load, 2-load and 3-load plants are small portable plants used mainly in countries outside the U.S. (See also *relocatable* and *stationary* asphalt facilities.)

positive displacement pump. The type of positive displacement pump widely used in the HMA industry is a gear pump. (See *gear pump*.)

power panel. A metal panel that encloses parts used to control and distribute electrical power to a HMA facility or one of its major units. On stationary HMA facilities, power panels are installed in the control house. On portable and relocatable facilities, the power panels are mounted on some of the key units.

power supply. A variety of power supplies are used in Astec HMA facilities to convert alternating-current to direct-current. Several are used in the PM-96 computer to provide a variety of dc voltages to the circuit boards and sensors, such as load cells and tachometers.

An un-interruptible power supply, known as a UPS, is used to power the PM-96 computer. It contains batteries that prevent loss of power to the computer if the main power is interrupted for any reason.

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precipitator. Electrostatic filtering equipment used in a HMA facility to remove blue smoke during production and loadout of HMA.

pressure drop. A decrease in pressure between two points in a current of air (or fluid) caused by resistance to flow.

primary air. That part of the combustion air that enters through the burner, atomizes the fuel and combines with it during combustion. (Compare *secondary air*.)

Process Mate. An Astec trademark for the computer used to automate the control of a HMA facility. (See *PM-96*.)

production rate. Usually stated in tons per hour (tph) for continuous mix HMA facilities. For a batch plant, the production rate is usually stated as the maximum amount of HMA it can produce in a single batch.

pugmill. A machine for mixing the ingredients of HMA. A pugmill can be designed for either batch operation or continuous operation. Astec's main use of pugmills is in batch plants. One is located in the batch tower.

The typical batch plant pugmill contains two shafts, each with several mixing paddles, that rotate in a housing. The hot dry materials enter the housing from above. A spray bar across the top of the housing injects liquid AC into the dry materials after they have mixed for about 3 seconds. The mix, now including the AC, continues mixing for another 30 seconds.

A gate on the bottom of the housing opens for about 6 seconds to discharge the HMA. The total cycle takes about 39 seconds.

pulley. A wheel. In Astec HMA facilities, pulleys are used with conveyor belts, drive belts and wire rope. They have a wide variety of rims, which may be grooved, flat, slightly convex or may have disks. Pulleys are similar to idlers, but there are important differences. Both support loads from the belts. However, pulleys can be either driven or non-driven, whereas idlers are not driven. Pulleys either pull the belt or change its direction of travel, whereas idlers do neither. Pulleys with grooved rims are also called sheaves,

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especially those used with wire rope. Wheels with teeth used with roller chain are known as sprockets.

radial joint. A joint around the outer circumference of a cylinder, usually where two cylindrical joints meet each other. A radial joint is at right angles to the length of the cylinder.

radiation. A process of heat transfer whereby heat energy resembling light rays or waves travel in a straight line through space, even a vacuum.

The key role of radiation in a helical coil heater is that of heating the coil surfaces that directly face the burner flame. The radiant energy heats the coil surfaces, even though the actual flame does not impinge the surfaces.

rake-out flights. Discharge flights. (See *flights*.)

rake-out rings. Rings that prevent material from accumulating in the ends of the mixing chamber of the Double Barrel mixer.

The one at the burner end catches any dried aggregate that went the wrong way after emerging from discharge ports in the inner drum and diverts it back into the main flow of material.

The one at the other end of the mixer catches any mix that misses the discharge port and diverts it back to the discharge port.

RAM. Acronym for *Reclaimed Aggregate Material*, which is removed pavement materials containing no reusable binding agent (asphalt cement).

RAP. Acronym for *Reclaimed Asphalt Pavement*. RAP is sometimes erroneously interpreted to mean *Recycle Asphalt Product*, which means virtually the same thing, but is less specific than *reclaimed asphalt pavement*. Note that RAP contains asphalt cement, whereas RAM does not.

RAP bins. Bins used in a HMA facility to hold RAP and feed it to conveyors, which take it to screens and crushers and on to the mixer.

Reclaimed asphalt pavement (RAP). Asphalt paving material recovered from old road beds either by milling or excavation by

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ripping. It includes aggregate as well as reusable binding material (asphalt cement).

RAP produced by milling can be hauled to the asphalt plant and recycled by adding it directly to virgin HMA. RAP produced by excavation is usually in the form of large chunks, which must be crushed before it can be used at the asphalt plant.

recycle. When used as a verb, recycle means to *reuse*. When used as a noun, recycle is jargon for RAP.

recycle material. Commonly used to mean RAP, but could also mean RAM.

recycling. Reuse of reclaimed asphalt pavement in construction of new roadways and other structures.

refractory. A fire-resistant brick or material commonly used to line the inside of a heating chamber or the area surrounding a burner. Refractory linings are sometimes used to increase the combustion efficiency of a burner. Improved combustion efficiency decreases the amount of combustion byproducts, thereby reducing unwanted emissions.

relocatable asphalt facility. A facility that has fixed steel foundations built into its major components. The components are set up with the steel foundations or skids resting directly on the ground without the use of concrete foundations.

The units can be transported from one location to another over public highways on flat bed trailers pulled by a conventional fifth-wheel tractor. Cranes are usually required for erection.

Each major component is prewired. At the plant site the components interconnect with rubber jacketed electrical cables furnished with the equipment.

Astec developed the original relocatable facility to provide advantages of both a stationary and portable facility. Astec's relocatable facility is trade named *M-Pack*. (See also *portable* and *stationary* asphalt facilities.)

retaining wall. (See *bulkhead*.)

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retention time. Usually refers to mixing time, but could mean the amount of time materials remain in equipment or any part of it. (See *mixing time*.)

roller. Cylindrical wheels used in roller chain, roller bearings or as trunnions.

roller bearing. A type of bearing commonly used in HMA equipment. A roller bearing contains a number of cylinder-shaped rollers. Some types of roller bearings have spherical rollers. Others have tapered rollers.

Different applications impose different types of loads (thrust or radial or a combination of the two) on the bearing and this governs which type of bearing should be used.

roller chain. A series of steel links connected with pins to form a flexible belt. The pins are fitted with rollers. The chain is driven by a sprocket which engages the rollers. Roller chain is the key part of a drag conveyor or hot elevator. It is also used for saddle chain drives. (See *drag conveyor*, *hot elevator*, and *saddle chain drive*.)

rotary air lock. A type of valve used in piping for baghouse fines, lime or other types of powder-like material. The valve has rotating vanes that move the material through the valve without allowing air to flow with it, even where there is differential air pressure on each side of the valve.

R-value. A measure of the ability of a material, such as insulation, to *resist* or *impede* heat flow. Increasing values denote greater resistance to flow. **R-value** is the most common number used to compare the insulating properties of various materials. It is typically marked on the wrapper or container of the material. The **R-value** per inch of thickness is the reciprocal of heat conductance (**k**), which is the ability of a material to *conduct* heat flow. Thus, the **R-value** is equal to one divided by **k**.

For example, a fiberglass batt one inch thick has a **k** value of 0.30. One divided by 0.30 gives an **R-value** of 3.33. For a thickness of six inches multiply the one-inch **R-value** by six, which gives an **R-value** of 19.99. For a thickness of 12 inches multiply the one-inch **R-value** by 12, which gives an **R-value** of 39.96.

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saddle chain drive. A type of roller chain drive system commonly used to rotate a dryer or mixer drum. The entire chain runs under the drum and makes a loop around two sprockets, a drive sprocket and an idler sprocket. The upper half of the loop engages another sprocket, which encircles the drum.

sampling valve. A special type of valve that enables an operator to easily take samples of liquid from a tank. They are often used on liquid asphalt storage tanks. In a horizontal asphalt tank the valve is usually installed in one end, about 24 inches above the bottom. In a vertical asphalt tank it is installed in the side, about the same height above the bottom.

Sampling valves for use with asphalt tanks are usually manually operated and feature a screw stem operated by a hand crank. They are virtually clog-free because of the way the valve is designed and mounted in the tank. (They do not need a hot oil jacket.) Moreover, they are usually leak-free and provide free-flow.

Gate valves and other types of valves are sometimes used for taking asphalt samples, even though such valves are not designed for sampling. They often clog and require use of a torch to heat them and their connections to get the material to flow. But valves specifically designed for sampling virtually eliminate the hazards and difficulty associated with valves not designed for that purpose.

SBR. Styrene-butadiene-rubber. A polymer that is often mixed with asphalt cement to produce modified asphalt.

SBS. Styrene-butadiene-styrene. A polymer or common synthetic rubber that is capable of withstanding high temperatures and extreme tearing forces. It is often mixed with asphalt cement to produce modified asphalt.

scalping screen. A wire mesh screen, which passes material small enough to go through the spaces between the wires and withholds or separates material larger than the spaces between the wires. Screens with various mesh sizes are used in making HMA.

scavenger coils. Usually, the coils in a direct-fired tank that scavenge heat from the heated asphalt. (See *direct-fired tank*.)

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SCR. Silicon Controlled Rectifier. A solid-state electrical device that controls the amplitude of current or voltage in an alternating current circuit. In Astec HMA facilities, belt feeder drives have SCRs to control magnetic clutches. (See *belt feeder*.) The SCR is controlled by an independent control circuit.

scraper blade. Normally used on the head shaft of a conveyor to clean the belt. Sometimes a brush is used instead.

screen mesh sizes. (See *mesh numbers*.)

screw conveyor. A conveyor with a helical screw (auger) that rotates in a tubular housing or trough. It is used mainly to convey dust, lime or other powder-like material.

scrubber. Equipment used to remove dust particles from the gas stream of the aggregate drying process. Water spray is showered through the dust-laden gas stream thereby scrubbing it and removing most of the particles.

The resulting slurry of water and dust is pumped to a pond where the dust particles sink to the bottom of the pond and form a sediment. The sediment is not reused to make HMA.

In a modern HMA facility, scrubbers have largely been replaced by baghouses. Baggouses are more effective and more efficient. Depending upon the mix design, some or all of the baghouse dust or fines can be used in the mix, a significant economical advantage.

secondary air. On an open-fired burner (Hauck Starjet) it is that part of the combustion air that enters the dryer *around* the burner and not through it. This is air drawn into the combustion zone by the baghouse fan. Most of this air is needed to attain complete or stoichiometric combustion. (Compare *primary air*.)

segmented sprocket. A sprocket that is made in several pieces to facilitate replacement. The sprockets in drag conveyors are usually segmented sprockets, allowing replacement of worn segments while the drag chain remains in place.

segregation. An unwanted separation of larger sized aggregate from smaller sized aggregate after the aggregates have been mixed with each other.

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Segregation usually occurs as a result of moving mixed material from one place to another. When mixed material flows into a pile, the larger pieces tend to roll off the top of the pile to one side while the smaller pieces remain near its center. This, of course, segregates the material. Special techniques are used to avoid segregation.

seismic. A word often used in connection with building codes that apply to structures in a HMA plant to denote the amount of earthquake activity they can withstand without damage.

self-erect. A term indicating the way in which units of some HMA facilities are set up for operation. It means that the unit incorporates mechanisms that erect the unit without the need for cranes, winches or other such equipment.

sensor. A device that receives and responds to certain stimuli or conditions. It usually produces or controls an electrical signal that activates other controls or indicators. Several types of sensors are used at HMA plants. A thermocouple is a type of sensor used to measure temperature. A photoelectric cell is a type of sensor that reacts to light. A pressure switch is a sensor that reacts to air or fluid pressure. An O₂ sensor measures the amount of oxygen in a gas stream.

serpentine coil. A piece of pipe curved back and forth along its length creating a form resembling a serpent. Serpentine coils are commonly used for heating in asphalt storage tanks and in some hot oil heaters. The coil is sometimes finned to increase its heat conducting surface area. Compare with *helical coil*.

set point. The *optimum* or *desired* value of the temperature, level, pressure, flow, etc. that a control system is set to produce. This value may differ from the value that the system actually produces or the process variable (pv). The difference between process variable and the set point is known as the deviation. For example, if a system is set to produce a temperature of 325 degrees F (the set point) and it actually produces a temperature of 330 degrees F (the process variable), the deviation is 5 degrees.

Hot Mix Glossary

shim. To insert timbers or other materials under a leg or support pad of equipment in a HMA facility to make it level or to adapt it to an uneven surface.

shingles. Roofing material containing asphalt materials that can be recycled for use in HMA.

shipping container. Usually an insulated container for shipping AC as a bulk liquid. The container is normally capable of maintaining the AC in a liquid state for several days without applying heat.

Some containers contain coils through which hot oil can be pumped to restore heat to the material. Others contain a fire tube to which a burner can be attached and operated to restore heat to the material.

SHRP. See *Strategic Highway Research Program*.

Siefer mill. The brand name of a grinding mill used in polymer asphalt blending systems. The mill is commonly used to grind SBS polymer after it has been introduced into the asphalt cement and makes multiple passes through the mill.

sight glass. A glass tube used to indicate the level of liquid in a tank. It is mounted adjacent to a tank and is piped to the tank in such a way that the liquid in the tube is at the same level as the liquid in the tank.

silencer. A device used at a HMA plant to limit noise propagated by burners, fans or other components. (See *noise control*.)

silo. A tall cylindrical structure for storing HMA or materials used in making HMA, such as lime or baghouse fines. (See *storage silo*.)

single-pass fire tube. A type of fire tube in a direct-fired asphalt storage tank. A single-pass fire tube runs the length of the tank. It has an exhaust stack on the opposite end of the tank from the burner. Thus, the burner gasses travel the length of the tank once before passing out of the exhaust stack. See *two-pass fire tube*.

Six Pack. The trademark for a portable asphalt facility produced exclusively by Astec.

Hot Mix Glossary

skid. A rectangular structural steel framework that supports multiple parts that make up a major unit of a relocatable or stationary facility. Some parts mount directly on the framework without the use of legs.

On relocatable facilities the framework rests directly on the ground. Its load bearing surfaces are large enough to keep ground loading to no more than 2500 pounds per square foot, a load easily supported by most compacted soils.

On stationary facilities the framework rests on concrete foundations. Consequently, its load bearing surfaces are smaller than those on a relocatable unit.

Hot oil heaters and their associated equipment are commonly mounted on skids. (Compare with *steel foundation*.)

slat conveyor. (See *drag conveyor*.)

slinger feeder (conveyor). An aggregate conveyor that is operated at higher than normal speed causing it to sling the material directly into the drum of a dryer. It is sometimes used instead of a gravity feed chute in areas where the aggregate is usually wet and sticks to gravity chutes.

sock filter. A type of filter used in the hot oil line of a hot oil heater. The filter is long and shaped somewhat like a sock. It is made of a fine fabric mesh which collects dirt and debris from the hot oil flowing through it. Sock filters are very effective and are highly recommended for use with hot oil heaters to protect the hot oil pump. They are especially recommended for new installations and when replacing an old heater with a new one.

sound level meter. An instrument for measuring sound pressure levels. The instrument is usually calibrated in decibels. Sound level meters are often used to measure sound pressure levels at HMA plants to determine whether the plant complies with noise ordinances and hearing standards.

specific heat of asphalt. The amount of heat (0.5 Btu) that is required to raise the temperature of one pound of asphalt cement one degree F.

Hot Mix Glossary

spherical roller bearing. A type of bearing with rollers that have a spherical surface instead of a straight cylinder, as on a conventional roller bearing. Spherical bearings are used in pugmills and other heavy-duty applications, where fore-and-aft thrust and radial loads are encountered.

SPL. Sound pressure level. The amount of sound at a specific point or location. Sound pressure levels are usually measured in decibels. Sound pressures above certain levels may impair the hearing of persons exposed to those levels over a period of time. Consequently, sound pressure levels are often measured at predetermined distances from noisy equipment at HMA plants to determine the safety of working near the equipment. Moreover, sound pressures, even at lower levels, may be annoying to communities located near HMA plants. Consequently, allowable SPLs at property lines may be governed by ordinances.

sprocket. A wheel with projecting teeth that engage links of a chain.

stack. (See *exhaust stack*.)

starter. Each alternating current electric motor used in Astec HMA facilities requires a starter. A starter is a remote-controlled electrical device that connects electrical power to the motor. The starter incorporates a thermal overload switch that disconnects the motor in the event that the motor draws excessive current.

stationary asphalt facility. A facility whose major components are designed to set on concrete foundations at the job site.

Major components can be transported from one location to another over public highways on flat bed trailers pulled by a conventional fifth-wheel tractor. However, major components of large facilities may have to be shipped as pieces or as sections.

Cranes are required for erection. Although major components are prewired, interconnecting wiring is not usually furnished with the equipment, but is usually installed at the site and run in conduit. (See also *portable* and *relocatable* asphalt facilities.)

Hot Mix Glossary

steel foundation. A built-in structural steel base that supports all or part of a major unit of a portable or relocatable facility. Some steel foundations use steel plate as the load bearing surface whereas others use rectangular steel tubes.

Steel foundations have large bearing surfaces so as to keep ground loading to no more than 2500 pounds per square foot, a load easily supported by most compacted soils. Thus, steel foundations eliminate the need for either supporting timbers or concrete foundations.

The foundations are joined to the structures of equipment they support via steel legs. Stationary HMA facilities do not have built-in steel foundations. Their legs are normally set directly on concrete foundations. (Compare with *skid*.)

stockpile. A pile of material, usually aggregate or RAP, used as an ingredient of HMA. Stockpiles are usually created and maintained by dump trucks unloading material into piles on the ground. In most facilities, front-end loaders scoop up material from the stockpiles and empty it into either cold feed or RAP bins.

stoichiometric air. The amount of air needed for a chemically correct ratio of fuel to air. This is the ratio capable of perfect combustion so that there is no unused fuel or air.

storage. Storage of HMA usually means accumulating and holding it before use for a period of several days. Compare *storage* and *surge*.

storage bin. A term commonly used to mean the same thing as *storage silo*. *Silo* usually denotes a cylindrical structure, but the term bin may refer to structures of other shapes.

storage silo. Although this term may refer to silos for storing a variety of materials, the word *storage* has special meaning. Storage means the ability to hold the material long term. Long term storage of HMA means keeping it without deterioration for several days. Consequently, silos used for storing HMA are heated and fully insulated whereas silos used only for surge or storing unheated materials are not.

Hot Mix Glossary

storage tank. A tank for storing liquid used in the production of HMA. Some liquids are ingredients of HMA, such as asphalt cement and anti-strip agents. Other liquids include fuel oil, used to fire the dryer and hot oil heaters.

strainer. A type of filter used to remove debris or foreign material either from hot oil or liquid asphalt. Strainers are used to protect pumps downstream from the filter. Strainers have a filter basket, either of perforated metal or wire mesh. A common mesh opening is 3/64-inch for hot oil and 9/64 for asphalt.

A Y-strainer is the type most commonly used. In order to replace or clean the basket of a Y-strainer used in a hot oil line it is necessary to shut down the heater and to shut off the line to the filter.

A duplex strainer is another type of strainer sometimes used. It has two independent strainers and a valve that allows switching from one to the other. One can be serviced while the other operates, eliminating the need to shut down the system.

Strategic Highway Research Program. A program led by the Federal Highway Administration to specify, test and design asphalt paving materials for highways in the United States. Testing under this program indicates that roads last remarkably longer when made with asphalt binders that incorporate modifiers. The SHRP also gave birth to a new system of grading asphalt cement or binders known as performance-grading. The use of modified asphalt has begun to increase significantly in the United States and is due mainly to the SHRP.

stripping. A defect that may occur in HMA. It is a weakening or loss of adhesive bond between the aggregate surface and the asphalt cement caused by the interaction of moisture. Additives known as anti-stripping agents are often used to improve the bond, making the mix less susceptible to stripping. (See *anti-stripping agent*.)

struck. A term used in connection with the capacity of a bin (*struck capacity*) to mean the capacity of the bin with material filled to its top edges, and material near its center struck or made even with the edges. (Compare *heaped*.)

Hot Mix Glossary

Superpave. The name of a system developed by the Strategic Highway Research Program (SHRP). The Federal Highway Administration developed and validated Superpave specifications and test procedures and initiated a national program to encourage the adoption of the Superpave system. The Superpave system primarily addresses two pavement distresses: permanent deformation, which results from inadequate shear strength in the asphalt mix; and low temperature cracking, which is generated when asphalt pavement shrinks and the tensile stress exceeds the tensile strength.

Super Six Pack. A portable asphalt facility produced exclusively by Astec.

surge. A rapid increase in the volume of material in a container caused when the rate of the material coming into the container exceeds the rate of the material going out of the container.

surge bin. A bin for accumulating and containing surges of HMA for short periods of time without having to stop production. Surge bins facilitate faster loading of trucks and improve plant efficiency. However, surge bins are not intended for long term storage and must be emptied before the mix loses its ability to flow.

surge pot. A small vessel for accumulating surges of dust or other fine material to provide a reserve of the material and to help maintain a constant flow in its system.

swing hammer. A component in a hammermill. (See *impact crusher*.)

tachometer. A device that encodes electrical signals to indicate the rpm (revolutions per minute) that a shaft is rotating. Tachometers are used on belt feeders and conveyor belts. Output from a tachometer is combined with output from load cells to indicate feed rate. (See *belt feeder*.)

tank container. See *shipping container*.

telescoping legs. Legs that are adjustable in length. Major components of portable HMA facilities come with telescoping legs that attach to steel plate foundations. When portable units are

Hot Mix Glossary

furnished without steel plate foundations the legs have pads intended to rest on the concrete or supporting timbers.

tertiary air. On a sealed-in total air burner (Hauck Eco-Star and Powerstar) it is that part of the combustion air that is supplied by a tertiary fan and is the equivalent to the secondary air of an open-fired burner.

therm. The amount of fuel required to produce 100,000 Btu. It takes approximately 0.756 gallons of No. 2 fuel oil at LHV to produce one therm. It takes approximately 110.497 cubic feet (1.1049 CCF) of natural gas at LHV to produce one therm. Suppliers of natural gas may bill their customers either by the hundred cubic feet (CCF) or by the therm. It is important to note that natural gas suppliers normally calculate a therm based on the HHV of natural gas, which is approximately 96.154 cubic feet (0.961 CCF) per therm.

thermal fluid. Also called *heat transfer oil*. A special fluid used to transfer heat in heating systems for HMA facilities. In a typical application, a fired heater heats coils of metal pipe through which the fluid flows. The fluid absorbs heat from the pipe. The fluid circulates to remote equipment through insulated lines that minimize heat loss. As the fluid circulates through the equipment its heat is transferred to the equipment and material inside it.

A variety of thermal fluids are available from different producers. *Caloria HT-43*, a petroleum-based heat transfer fluid from Exxon Corp., is widely used in asphalt heating equipment. It is suitable for temperatures up to 600 degrees F.

Synthetic fluids, such as *Dow Therm A* from the Dow Chemical Company, are suitable for other applications where temperatures up to 750 degrees may be encountered.

thermocouple. A device used in the measurement of temperature. A thermocouple usually consists of two wires of dissimilar metals joined at one end. Heating the joint causes it to produce a small voltage that is in proportion to the temperature.

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thrust rollers. The roller at each end of a dryer drum to constrain any fore-and-aft movement of the drum. They are also used on the drums of drum mixers, including the Double Barrel mixer.

ticket window. A window in the control house of a HMA facility. The window enables facility operators to pass tickets to truck drivers while they remain in their trucks after they receive a load of HMA.

Timken. A trademark of The Timken Company. Astec uses Timken tapered roller bearings, widely known for their high quality, on their dryers and Double Barrel mixers.

tire. A large steel ring used on drum dryers and drum mixers. Two tires are used to support the drum. They encircle the drum and are attached to it by a series of spokes. Each tire rides on two trunnions, one on each side of the frame.

tph. Abbreviation for *tons per hour*. Unless noted otherwise, a ton in Astec publications refers to a short ton (2,000 pounds.)

traverse conveyor. One or more conveyors used atop multiple storage silos to selectively transfer HMA from the single inclined drag conveyor to various silos. Traverse conveyors are actually drag conveyors that operate horizontally.

Tri-Ten. A trademark of United Steel Corporation for a high-strength, low alloy steel plate. Dryer drums are usually made either from this type of steel or a similar steel trade named Cor-Ten. These steels are also used for certain parts where high strength and resistance to rusting are needed.

truck scale. A weighing platform for weighing trucks before and after they are loaded with HMA.

Astec builds a totally electronic scale trademarked Weigh Mat. It comes in a variety of sizes, has a low profile and is installed directly under the storage silos.

Its platform has checkered-steel deck plates. Its only foundations are small pads at each load cell. The scale can be used with all electronic digital readout units, ticket printers and data collection terminals.

Hot Mix Glossary

trunnion. A steel roller used to support drum dryers and drum mixers. Two trunnions support each tire.

two-pass fire tube. A type of a fire tube in a direct-fired asphalt storage tank. A two-pass fire tube runs the length of the tank and doubles back towards the burner. It has an exhaust stack on the same end of the tank as the burner. Thus, the burner gasses travel the length of the tank twice before passing out of the exhaust stack. A two-pass fire tube is much more efficient than a single-pass fire tube. See *single pass fire tube*.

unloading pump. A pump used to transfer liquid asphalt from the tank of a delivery truck to a storage tank at a HMA facility. On portable plants the pump is usually mounted on the gooseneck of a portable storage tank. On relocatable plants the pump is usually mounted on the same skid as the hot oil heater. On stationary plants the pump is usually independently mounted at a location that will conveniently serve two or more storage tanks.

The pumps used are usually positive-displacement gear pumps. They range in size from 3 to 5 inches, providing 200 to 450 gpm respectively. The time it takes to unload tanker trucks delivering liquid asphalt cement to a HMA facility depends upon the size of the unloading pump and connecting lines.

A 3-inch pump unloads 200 gpm and takes 30 minutes to unload a tanker with 6,000 gallons of liquid asphalt cement. But a 5-inch pump unloads 450 gpm and takes only 13.3 minutes to unload the same tanker. Thus, a 5-inch pumping system saves 16.7 minutes per truck load.

A facility that runs 150,000 tons of hot mix a year using 5 percent liquid AC can save about \$4400 by switching from a 3-inch pump to a 5-inch pump. This is based on a savings of \$13.88 per truck load, 320 truck loads and a trucking cost of \$50.00 per hour.

UPS. Un-interruptible Power Supply (See *power supply*.)

up stream. One of two directions in a gas stream of a dryer or heater. *Up stream* means the direction *towards* the burner. *Down stream* means *away from* the burner.

Hot Mix Glossary

variable speed drive. A variable speed drive system used for belt feeders. (See *belt feeder*.)

veil. The effect produced when aggregate is picked up by flights in a dryer and showered through its hot gas stream. The ideal drying condition is produced when the veil stretches across the whole cross section of the drum.

vent. An opening through which air and gases can escape. Vents are commonly used in several components of a HMA facility, such as asphalt storage tanks and silos. Condensers are commonly used on vents for tanks that contain materials that produce volatile organic compounds (VOCs). See *condenser*.

vertical asphalt tank. A cylindrical tank used at a HMA facility to heat and store asphalt cement. The tank is installed so that its long axis is upwards and it occupies a ground area only the size of its diameter. Another advantage is that the surface of asphalt cement in the tank has a smaller area than the same amount of liquid in a horizontal tank. Thus, there is less oxidation of the asphalt cement. Moreover, the liquid in vertical tanks has better flow patterns than in horizontal tanks when mixers are installed to keep polymers in suspension. However, vertical tanks are less suited for portable tanks than horizontal tanks. See *horizontal tank*.

vertical curve conveyor. A belt conveyor sometimes used in a cold feed system to serve as both a collecting conveyor and inclined conveyor. The belt at the low end of the conveyor is horizontal and runs under the feeder belts of the cold feed bins. The belt extends horizontally for short distance and then turns upward.

The upward turn may be as a radius (a true vertical curve.) Or the turn may take the form of two angular changes of direction to simulate a vertical curve. The conveyor usually empties onto a scalping screen or onto another conveyor.

vertical cyclone. (See *cyclone*)

vibrator. A device used on bins and inlet chutes of drum dryers and drum mixers to prevent material from sticking to them.

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virgin aggregate. Aggregate not previously used in paving products.

virgin asphalt. Asphalt cement not previously used in paving products.

VOC. Abbreviation for Volatile Organic Compound.

waste. Material not suitable for inclusion in a particular HMA mix. Sometimes a portion of the baghouse fines produced by the drying of aggregate becomes waste. Some mix designs limit the amount of baghouse fines in the mix. Thus, fines produced in excess of that amount is waste.

wc (water column). An indication of the amount of suction produced by a fan or other device that produces a pressure differential. Usually stated in inches.

weigh hopper. A hopper used to weigh hot aggregates in a batch tower before the aggregate is dropped into a pugmill for mixing. The hopper is mounted on load cells.

weigh idler. A part of a belt scale. (See *belt scale*.)

Weigh Mat. A trademark of Astec Industries for a truck scale. (See *truck scale*.)

weigh pot. A pot used to weigh liquid asphalt cement in a batch tower before the cement is dropped into a pugmill for mixing. The pot is mounted on load cells.

wet mixing time. (See *mixing time*.)

wet scrubber. (See *scrubber*.)

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USEFUL INFORMATION

Energy Produced By Two Common Fuels*				
Fuel	Btu		Therms	
	LHV	HHV	LHV	HHV
No. 2 Fuel Oil	132,000 per gallon	140,000 per gallon	1.323 per gallon	1.400 per gallon
Natural Gas	905 per cu ft	1040 per cu ft	0.009 per cu ft	0.010 per cu ft
Amount Required To Produce One Therm				
One Therm (100,000 Btu)	Gallons of No. 2 Fuel Oil		Cu Ft of Natural Gas	
	LHV	HHV	LHV	HHV
	0.756	0.714	110.497	96.154
*The actual energy produced by these fuels may vary somewhat. However, the values shown here are widely used.				



HEATEC
an Astec Company

Heatec, Inc. • P.O. Box 72760 • Chattanooga, TN 37407
Tel: 1-800-235-5200 • FAX 423-821-7673