

4.2.2.6 Paper Coating

4.2.2.6.1 Process Description¹⁻²

Paper is coated for various decorative and functional purposes with waterborne, organic solventborne, or solvent-free extruded materials. Paper coating is not to be confused with printing operations, which use contrast coatings that must show a difference in brightness from the paper to be visible. Coating operations are the application of a uniform layer or coating across a substrate. Printing results in an image or design on the substrate.

Waterborne coatings improve printability and gloss but cannot compete with organic solventborne coatings in resistance to weather, scuff, and chemicals. Solventborne coatings, as an added advantage, permit a wide range of surface textures. Most solventborne coating is done by paper converting companies that buy paper from mills and apply coatings to produce a final product. Among the many products that are coated with solventborne materials are adhesive tapes and labels, decorated paper, book covers, zinc oxide-coated office copier paper, carbon paper, typewriter ribbons, and photographic film.

Organic solvent formulations generally used are made up of film-forming materials, plasticizers, pigments, and solvents. The main classes of film formers used in paper coating are cellulose derivatives (usually nitrocellulose) and vinyl resins (usually the copolymer of vinyl chloride and vinyl acetate). Three common plasticizers are dioctyl phthalate, tricresyl phosphate, and castor oil. The major solvents used are toluene, xylene, methyl ethyl ketone, isopropyl alcohol, methanol, acetone, and ethanol. Although a single solvent is frequently used, a mixture is often necessary to obtain the optimum drying rate, flexibility, toughness, and abrasion resistance.

A variety of low solvent coatings, with negligible emissions, have been developed for some uses to form organic resin films equal to those of conventional solventborne coatings. They can be applied up to 1/8 inch thick (usually by reverse roller coating) to products like artificial leather goods, book covers, and carbon paper. Smooth hot melt finishes can be applied over rough textured paper by heated gravure or roll coaters at temperatures from 65 to 230°C (150 to 450°F).

Plastic extrusion coating is a type of hot melt coating in which a molten thermoplastic sheet (usually low or medium density polyethylene) is extruded from a slotted die at temperatures of up to 315°C (600°F). The substrate and the molten plastic coat are united by pressure between a rubber roll and a chill roll which solidifies the plastic. Many products, such as the polyethylene-coated milk carton, are coated with solvent-free extrusion coatings.

Figure 4.2.2.6-1 shows a typical paper coating line that uses organic solventborne formulations. The application device is usually a reverse roller, a knife, or a rotogravure printer. Knife coaters can apply solutions of much higher viscosity than roll coaters can, thus emitting less solvent per pound of solids applied. The gravure printer can print patterns or can coat a solid sheet of color on a paper web.

Ovens may be divided into from 2 to 5 temperature zones. The first zone is usually at about 430°C (110°F), and other zones have progressively higher temperatures to cure the coating after most solvent has evaporated. The typical curing temperature is 120°C (250°F), and ovens are generally limited to 200°C (400°F) to avoid damage to the paper. Natural gas is the fuel most often used in

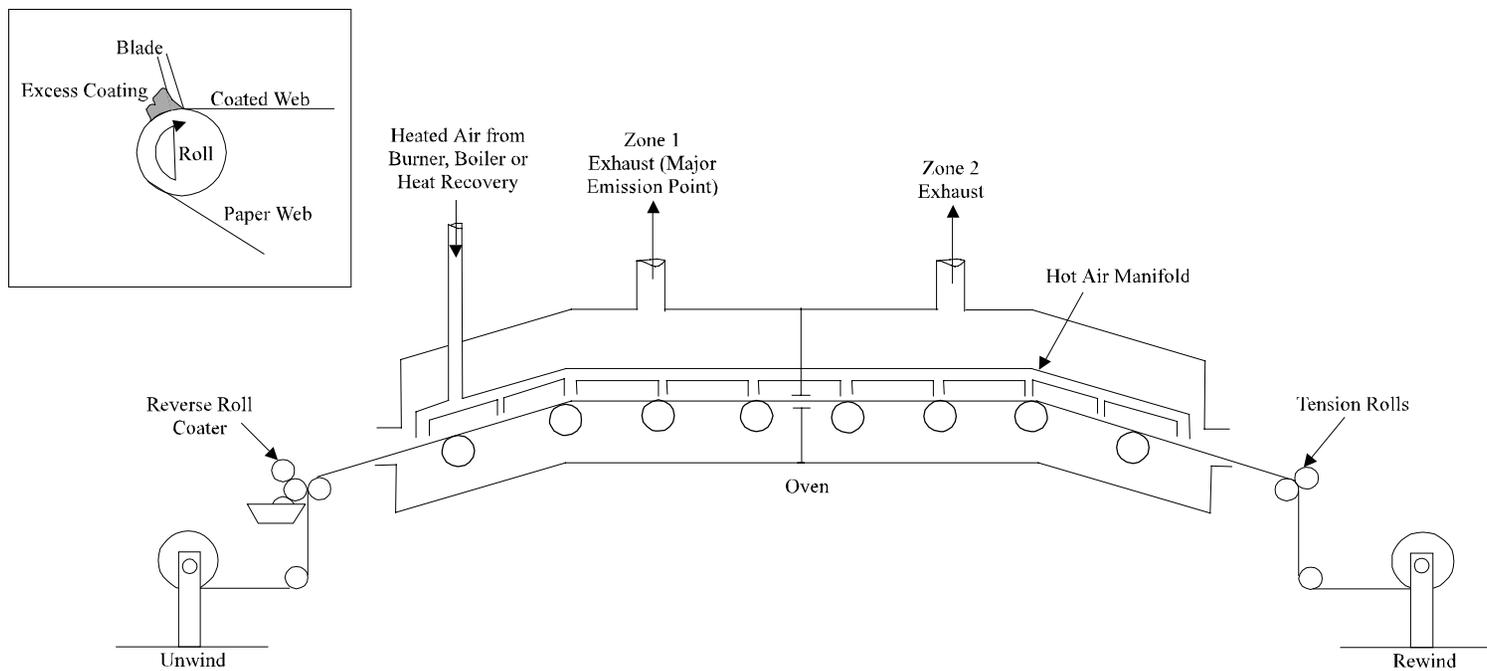


Figure 4.2.2.6-1. Paper coating line emission points.

direct-fired ovens, but fuel oil is sometimes used. Some of the heavier grades of fuel oil can create problems, because sulfur oxide (SO) and particulate may contaminate the paper coating. Distillate fuel oil usually can be used satisfactorily. Steam produced from burning solvent retrieved from an adsorber or vented to an incinerator may also be used to heat curing ovens.

4.2.2.6.2 Emissions And Controls²

The main emission points from paper coating lines are the coating applicator and the oven (see Figure 4.2.2.6-1). In a typical paper-coating plant, about 70 percent of all solvents used are emitted from the coating lines, with most coming from the first zone of the oven. The other 30 percent are emitted from solvent transfer, storage, and mixing operations and can be reduced through good housekeeping practices. All solvent used and not recovered or destroyed can be considered potential emissions.

Volatile organic compound (VOC) emissions from individual paper coating plants vary with size and number of coating lines, line construction, coating formulation, and substrate composition, so each must be evaluated individually. VOC emissions can be estimated from the factors in Table 4.2.2.6-1 if coating use is known and sufficient information on coating composition is available. Since many paper coating formulas are proprietary, it may be necessary to have information on the total solvent used and to assume that, unless a control device is used, essentially all solvent is emitted. Rarely would as much as 5 percent be retained in the product.

Table 4.2.2.6-1. CONTROL EFFICIENCIES FOR PAPER COATING LINES^a

Affected Facility	Control Method	Efficiency (%)
Coating line	Incineration	95
	Carbon adsorption	90+
	Low solvent coating	80 - 99 ^b

^a Reference 2.

^b Based on comparison with a conventional coating containing 35% solids and 65% organic solvent, by volume.

Almost all solvent emissions from the coating lines can be collected and sent to a control device. Thermal incinerators have been retrofitted to a large number of oven exhausts, with primary and even secondary heat recovery systems heating the ovens. Carbon adsorption is most easily adaptable to lines which use single solvent coating. If solvent mixtures are collected by adsorbers, they usually must be distilled for reuse.

Although available for some products, low solvent coatings are not yet available for all paper-coating operations. The nature of the products, such as some types of photographic film, may preclude development of a low-solvent option. Furthermore, the more complex the mixture of organic solvents in the coating, the more difficult and expensive to reclaim them for reuse with a carbon adsorption system.

References For Section 4.2.2.6

1. T. W. Hughes, *et al.*, *Source Assessment: Prioritization Of Air Pollution From Industrial Surface Coating Operations*, EPA-650/2-75-019a, U. S. Environmental Protection Agency, Cincinnati, OH, February 1975.
2. *Control Of Volatile Organic Emissions From Existing Stationary Sources, Volume II: Surface Coating Of Cans, Coils, Paper Fabrics, Automobiles, And Light Duty Trucks*, EPA-450/2-77-008, U. S. Environmental Protection Agency, Research Triangle Park, NC, May 1977.