Ink Components

- Pigments
  - Organic or inorganic particles for color
  - May be Metallic
- Solids (Binders)
  - Organic resins, polymers or oils
  - Anchors pigments to the substrate
- Solvents
  - Organic liquid, water or both
  - Dissolves and disperses the pigments

Five Common Types

- Letterpress
- Flexography
- Lithography (Offset)
  - Web
    - Heatset
    - Open (non-heatset)
  - Sheet-fed
- Gravure (rotogravure)
  - 1. Publication
  - 2. Packaging
- Screen Printing

(pp 200-28)
Printing Processes

• LETTERPRESS (FLEXOGRAPHIC) - RELIEF
• LITHOGRAPHY - PLANOGRAHIC
• GRAVURE - INTAGLIO
• SCREEN - STENCIL

Process Distribution

• LITHOGRAPHY - 50%
• GRAVURE - 25%
• SCREEN PRINTING - 15%
• LETTERPRESS - 10%

Letterpress Printing

• Oldest form of moveable type printing.
• Image is created using a plate with raised type and pressing it into the paper.
• Identified by impression coming through paper and squeeze out effect.
Basic Types

- Platen
- Flat-bed cylinder
- Rotary
- Belt

Ink System

- Inks Used with no dilution
- Heavy paste inks
- High VOC content
- Tend to be viscous and tacky
- Dry by a combination of oxidation, adsorption and absorption.
**Emission Points**
- The press
- The image carrier
- The inking system
- The dryer
- Chill rolls
- The printed product

(pp 200-5)

**Flexographic Printing**
- A relief method; image area raised above non-image area.
- The rubber image carrier transfers image to substrate.
- Exclusively used for gift wrapping.

(pp 200-7)

**Flexographic Printing**
- Rotary web “letterpress type” printing
- Simplest and least expensive method
- Can be used for long or short runs on a wide variety of substrates
**Equipment Description**

- Usually rotary machines
- Up to 8 ink color stations
- Ink distribution usually consists of a rubber fountain and Anilox roller
- Press types
  - Stack type
  - Central Impression cylinder
  - In-line

(pp 200-7 - 9)
**Emission Points**

- Solvent Based Inks
  - Ink Fountain
  - The press unit
  - The dryer (if present)
  - The printed substrate
- Ultraviolet-based Inks
- Water Based Inks
  - Press preparation
  - Clean-up operations

(pp 200-9)

**Lithographic Printing**

- Plate made by photochemically etching aluminum.
  (Uses the chemical principle that “Ink and Water do not mix.”)

(pp 200-12)

**Lithographic Printing**

- Most popular printing process
- Short, medium or long runs
- Image and non-image areas are electrostatically distinct because of fountain solution

(pp 200-12 & 13)
Ink System

- Low viscosity inks that dry very rapidly by evaporation
- Contain a variety of alcohols, ethers, waxes or plasticizers
- Historically high VOC
- Have organic solvent base and are frequently diluted.

(pp 200-9)

Lithographic Printing

Four Basic Steps

- Prepress
- Makeready
- Press
- Post Press

Lithographic Printing

- Prepress
  - Design and artwork
  - To image carrier
    - Photo processing
    - Digital transfer
Lithographic Printing

- Makeready
  - Attaching plates to presses
  - Adding ink and fountain solution to each printing unit
  - Alignment of copy (registering)
  - Proofing

- Press
  - Actual printing
  - The inks, solvents and final substrates are used
  - Has to meet customer specifications

- Post Press
  - Cutting, Trimming, gluing and binding
  - Final packaging
  - Cleanup
Offset Lithography

Ink Rollers
Dampening Rollers (system)
Substrate
Impression Cylinder
Transfer Cylinder

Plate Cylinder
Blanket Cylinder
Printed Image

Equipment Description

• Planographic method
• Ink is applied to image on one cylinder, then transferred to a rubber image blanket on a different cylinder.
• The image is then transferred or “offset” to the substrate

(pp 200-13 & 14)
Ink System

- Inks are very heavy paste inks with low volatility
- Used as supplied by manufacturer (not diluted)
- Inks dry by adsorption or absorption into the substrate

(pp 200-14 & 15)
Emission Points

- Ink fountains
- Dampening system
- Plate and blanket cylinders
- The dryers
- The chill rolls
- The printed product
- Clean-up operations

Gravure Printing

- Image area is etched (depressed) on a copper or chrome plated cylinder, then, inked and wiped. The image is then transferred to paper that is held against the gravure cylinder by a rubber covered impression cylinder.

Gravure Printing

- Rotogravure: Web-fed Gravure
  - Newspaper print
  - Magazines
  - Catalogs
  - Packaging Materials
Gravure Printing

- Excess ink removed by doctor blade
- Printed substrate dries primarily by evaporation
- High plate making costs
- High quality illustrations with excellent color contrast

(pp 200-19)
Rotogravure Printing Types

- Publication
- Packaging

Publication Rotogravure

- Rotogravure printing upon paper which is subsequently formed into books, magazines, catalogues, brochures, directories, newspaper supplements, and other types of printed materials.

Packaging Rotogravure

- Rotogravure is printing upon paper, paperboard, metal film, plastic film, and other substrates, which are formed into packaging products and labels.
Ink System

- Publication Inks
  - Comprised of modified resins, pigments and hydrocarbon solvents
  - Low viscosities
- Packaging Inks
  - Made up of nitrocellulose and various modifiers
  - Low viscosities

Emission Points

- Ink Fountains
- The press units
- The drying units
- The printed products
- Press preparation and cleanup

Screen Printing

- Ink passes through a porous screen of silk, Nylon, Dacron, Polyester or stainless steel mesh to which a refined form of stencil has been applied
- Different stencil for each color
- Very versatile
Screen Printing

Stencil
Squeegee
Screen
Printed Image
Substrate

(pp 200-23)

Equipment Description

- Main Components
  - A screen
  - A substrate
  - Delivery mechanism
  - Drying or curing device
  - Drying rack

(pp 200-24)
Ink System

- Paste-like consistency (Plastisols)
- Four major types
  - Ultraviolet curable
  - Water based
  - Plastisols
  - Solvent based
- Inks are frequently mixed

(pp 200-25)
**Emission Points**

- Fugitive Emissions
- Ink
- Solvents used for screen reclamation
- Clean-up operations

(pp 200-25)

**Special Printing Applications**

- Thermography
- Heat transfer printing
- Steel-die engraving
- Hot foil stamping
- Embossing
- Creasing and scoring (Bindery/finishing.)
- Perforating (Bindery/finishing.)

(pp 200-26 & 27)

**Control Technology**

- Low VOC inks, coatings and fountain solutions (soy based)
- Zero VOC (water based)
- UV curable inks
- Efficient air pollution capture and control equipment
  - Except for screen printing

(pp 200-25)
Control Technology

- Catalytic or Thermal Incineration
- Adsorption
- Cooler/Condenser Systems

Thermal Oxidation

- 95% + Destruction Efficiency
- 1600°F @ .75 sec. Residency Time
- May Require Supplemental Fuel
- Broadly Applicable
**Catalytic Oxidation**

- Similar to Thermal Oxidation
- \(600^\circ\) F – \(900^\circ\) F
- Catalyst on a Ceramic or Metal Substrate
- HAP Destruction Efficiencies of 95%
- Not For Streams With High HAP Concentrations

**Adsorption**

- Volatile HAPs Adsorbed on Surface of Solids
- AC Most Common Adsorbent
- HAPs Can Be Recovered and Reused
- 95% Removal Efficiencies Can Be Achieved
Adsorption

- Vapor to Liquid by Increasing Pressure or by Reducing Temperature
- Often a Pretreatment Device
- Allows HAP Recovery and Reuse
- Removal Efficiencies Around 90%

Refrigerated Condensation

- Vapor to Liquid by Increasing Pressure or by Reducing Temperature
- Often a Pretreatment Device
- Allows HAP Recovery and Reuse
- Removal Efficiencies Around 90%

Refrigerated Condensation
Regulatory Discussion

- Common Sections
  - Rule Applicability
  - Definitions
  - Exemptions
- Standards or Requirements
  - Control equipment
  - Clean-up requirements
  - Record keeping
  - Test methods

Rule Applicability

- District rule may not cover all facilities
- If a printing process is not specified under a graphic arts rule, then the operation should apply to another district rule.

Definitions

- Included in every rule
- Clarifies and standardizes industrial process, control, and enforcement terms
- Limited to terms specific to rule
Exemptions

• Included in all graphic arts rules
• Defines which printing operations and/or inks or materials are not subject to the rule.
• May refer to a type of process application, or a specific size of operation
• Example: “Small user” exemption

Standards or Requirements

• VOC content limits
• Emission control devices
• Cleanup operations
• Solvent usage and storage
• Recordkeeping
• Test Methods

Local Rule Discussion
Federal CTG Information

- RACT Determinations
- For Offset Lithography
- Includes:
  - Heatset inks
  - Non-heatset inks
  - Cleaning solutions

(Sec 300)

Federal NESHAPs

- Rotogravure & Wide-Web Flexographic Printing (>18” wide)
- Major Sources
  - 10 Tons/yr. of any Single HAP
  - 25 Tons/yr. of any Combination of HAPs

HAPs Control Options

- Thermal Oxidation
- Catalytic Oxidation
- Adsorption
- Refrigerated Condensation
**Inspection Procedures**

- Pre Inspection
- Inspection
- Post Inspection

(Sec 400)

**Air Pollution Control Points of Inspection**

- Capture
- Transport
- Air Mover
- Instrumentation
- Control
- Subsystem

(Sec 400)

**Capture**

- Are Process Emissions Drawn into a Collection/Control Device at the Point of Release?

(Sec 400)
• Are Emissions Moved to the Control Device Without Loss?
• Are There any Leaks?
Air Mover

• Is the fan big enough for the Job?
• Is it Operating as Designed and Permitted?

(Sec 400)
Instrumentation

• Are the proper instruments present?
• Do these instruments appear to be functioning?
• Are the instruments calibrated regularly?
• Are the instruments showing the appropriate units?
Control Device

• Is it Functioning?
• Are There Any Visible Leaks?
• Can the Device Handle the Job?

Subsystem

• What is the Ultimate Fate of the Captured Emissions?
Facility Inspection Procedures

• Ink Preparation Area
• Printing Press Area
• Drying and Curing Areas
• Clean-up Operations
• Storage Areas
• Control Devices
• Spent Solvent Storage & Disposal
• Usage Records

(pp 400-3 - 6)
Ink Preparation Areas

• Are Inks Thinned or Reduced?
• What Records Are Kept Here?

Printing Press Areas

• Press Operation
• Permit Review
• Line Speed

(pp 400-3)
Drying and Curing Equipment

• Dryers
• Collection Equipment
Clean-up Operations

• Clean-up Solvents
• Cleaning Process
• Waste Disposal
CARB 230.4 – Graphic Arts

Storage Areas

- Materials Verification
- Materials Storage
- Additional Equipment

Ink Data

- Total volatilities (weight percent)
- Water content
- Type, amount, and Batch identification
- Manufacturer’s ID #
- Ink Density

(Sec 400)
Sampling Inks/Coatings

- ASTM D 3925-81 (American Society for Testing Materials)
- Clean, dry metal containers
- Sample agitated to its original uniform condition
- Kept at 40°-100°F
- Deliver to lab promptly using proper chain of custody procedures
Control Equipment Information

- Emission Point
- Type
- Applicable Parameters
  1. Temperature
  2. Residence time
  3. Efficiency

(pp 400-5 & 6)
**USAGE RECORDS**

- Review Usage Records
- Alternative Compliance Plan Records
- Obtain Necessary Copies

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**VOC Capture and Destruction**

- Total VOCs
  - Fugitive
  - Captured
  - Consumed
  - Retained

---

**VOC Capture Efficiency**

\[
\text{VOC Capture Efficiency} = \frac{\text{VOCs captured}}{\text{VOCs emitted}} \times 100
\]

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOCs emitted (by emissions unit)</td>
<td>100 lbs</td>
</tr>
<tr>
<td>VOCs captured (to control device)</td>
<td>80 lbs</td>
</tr>
<tr>
<td>VOC capture efficiency (by calculation)</td>
<td>80%</td>
</tr>
</tbody>
</table>
VOC Control Efficiency

\[ \% \text{ CE} = 1 - \frac{\text{VOC emissions emitted (after control device)}}{\text{VOC emissions (Prior to control device)}} \times 100 \]

\[ 98 \% \text{ CE} = 1 - \frac{2 \text{ lbs/hr}}{100 \text{ lbs/hr}} \times 100 \]

VOC Calculations

A facility uses 100 lbs/hr of ink that has a VOC content of 35% by weight.

- 20% of the ink is retained on the substrate
- The incinerator has a 95% control efficiency

What are the lbs/hr of VOC emitted?

\[ \text{VOC Mass Emissions} = (100 \text{ lbs/hr}) \times (0.35) \times (1-0.20) \times (1-0.95) = 1.4 \text{ lbs/hr} \]

VOC Calculations

Including W/E

\[ \text{VOC g/l} = \frac{W_v - W_w - W_{ec}}{V_m} \]

Excluding W/E

\[ \text{VOC g/l} = \frac{W_v - W_w - W_{ec}}{V_m - V_w - V_{ec}} \]

\( W_v \) = Weight of all VOC compounds, as supplied, in grams
\( W_w \) = Weight of water, in grams
\( W_{ec} \) = Weight of exempt compounds, in grams
\( V_m \) = Volume of material, in liters
\( V_w \) = Volume of water, in liters
\( V_{ec} \) = Volume of exempt compounds, in liters
What About Violations?

- Notice To Comply (NTC)
  - Minor Deficiency
  - Non-Emissions Related
  - Non-Recurring

What About Violations?

- Notice Of Violation (NOV)
  - Emissions Related
  - Same Problem At Last Inspection

Reasons To Issue A NTC

- Incomplete Records
- Minor Equipment Change Without Notifying The AQMD
- Some Records Missing (If Not Emissions Related)
Reasons To Issue A NOV

- Exceeded Permitted Production Limit
- Missing Or Incomplete Information Necessary To Determine Compliance
- Open Container
- Material VOC Content Too High
- Control Equipment Malfunction
- Failed Source Test
- Same Violation As Their Last Inspection

Four Options After A NOV

- Continue To Operate In Violation
- Cease The Noncompliant Activity
- Correct The Problem
- Apply For A Variance