

**FLAT PANEL DISPLAY DEVICES  
POTENTIALLY HAZARDOUS CONSTITUENTS  
(Source: King County Report: End of Life Management:  
Flat Panel Displays Devices)**

**LEAD AND LEAD COMPOUNDS:** Primarily found in the solder used to make printed wiring boards and their components.

**MERCURY:** Used in the manufacture of cold cathode fluorescent lamps (CCFLs) that backlight LCD panels. A typical LCD uses 2 CCFLs but larger displays may use as many as 8. Estimate of mercury in a 15-inch LCD display assembly range from 4 to 10 milligrams of mercury.

**ANTIMONY:** Used as a flame retardant in telecommunications products.

**BERYLLIUM:** Small percentage (2-4%) is used in beryllium-copper alloys used in clips and “fingers” used in FPD assemblies.

**CADMIUM:** Most common use in nickel-cadmium batteries (mostly used in earlier laptop computers). Also used as a stabilizer in plastic components and as a color pigment. Cadmium sulfide is used as a phosphorescent coating on the inside of fluorescent monitor screen (5 to 10 g per screen) and is added to PVC plastic insulation of wires and cables as a plastic stabilizer and flame retardant.

**CHROMIUM VI or HEXAVALENT CHROMIUM:** Reportedly used as a hardener or stabilizer for plastic housings as well as a colorant in pigments. The quantities of Chromium VI are not well documented but are believed to be trace amounts.

**LIQUID CRYSTALS:** Approximately 1.2 g of liquid crystal mixture is used to manufacture a 15-inch LCD.

**INDIUM TIN OXIDE (ITO):** ITO electrodes are attached to the glass plates that sandwich the liquid crystals in LCD's. Approximately 0.5 g of ITO is used in each 15-inch display. *Indium is believed to be moderately toxic, with potential liver, heart and kidney effects. Mildly irritating when inhaled.*

**PLASTICS/PVC:** Main use of PVC plastic in flat panels is in the monitor housing and cables. Many PVC formulations may contain additional chemicals including: organotin, lead and cadmium-based stabilizers and plasticizing additives in flexible PVC, including **phthalates**.

**FLAME RETARDANTS:** Flame retardants have historically been used in various plastic electronic equipment components, including brominated flame retardants.

## **OTHER POTENTIALLY HAZARDOUS ORGANIC CONSTITUENTS IN FLAT PANEL DEVICES**

**PLEXIGLAS:** Plexiglas dust has been linked to occupational asthma.

**POLYOXYMETHYLENE (paraformaldehyde):** Used to manufacture the FPD base swivel bearing. It is a severe eye, skin and respiratory system irritant.

## **GENERAL FLAT PANEL DISPLAY ISSUES FOR DISSASSEMBLY**

FPDs are not designed for easy disassembly because:

- The fasteners are small and may be inaccessible, including clips, screws and adhesives.
- The designs of FPD's including the types and locations of fasteners and other components differs among FPD's so there is no standard disassembly method that can be used.
- Removal of mercury from the fluorescent backlights used in LCD's requires special equipment and many recyclers may be mismanaging these lamps since there is no demand for the recycling of FPD lamps. Mercury lamps may be shredded with the LCD screens.
- When FPD components are shredded, the resulting mix of materials is difficult to separate and output may contain a small amount of contaminant material.
- Plastics are difficult to identify by resin type.
- There may not be a market for polycarbonates from FPD's.

## **RECYLING OF LIQUID CRYSTALS AND LIQUID CRYSTAL MIXTURES**

Although recovery of liquid crystals from end-of-life LCDs is possible, there are a number of factors limiting the practicability of recycling the liquid crystals:

- The liquid crystal mixture in an LCD typically contains 25 components or more.
- Liquid crystal mixtures vary by manufacturer. Reclaimed liquid crystals would have to be separated and this would be cost prohibitive.
- Mechanical reclaiming of liquid crystals is not very efficient, because adhesive forces between the liquid crystals and the glass plates are high and lead to the risk of glass breakage.
- Extensive use of solvents is necessary to reclaim the liquid crystals; the use of these solvents is restricted by economic and regulatory considerations.

Few studies have been done on the human health risks in the occupational setting and ecological risk assessments for the residents who live in areas surrounding e-waste processing facilities.