7.0

CONCLUSIONS AND RECOMMENDATIONS

7.1 CONCLUSIONS

7.1.1 Emission Factors

Metal Welding

(1) Useful emission factors for metal welding were available for total chromium, nickel, lead and zinc.

(2) Hexavalent chromium emission factors were available for a very limited number of circumstances. A 95-percent confidence interval for the mean percentage of total chromium emissions represented by hexavalent chromium is 9 to 84 percent.

(3) No emission factors for cadmium were available. Review of material safety data sheets (MSDSs) for 20 commonly used electrodes did not indicate the presence of cadmium.

(4) Welding emission factors from the U.S. Environmental Protection Agency's *AP-42, Compilation of Air Pollutant Emission Factors* were reorganized by base metal. These factors were supplemented with factors from the literature.

Metal Cutting

(1) Metal cutting emission factors were available only for total chromium, nickel and zinc.

(2) The emission factor for total chromium from plasma arc cutting on stainless steel is based upon a single source test.

Metal Spraying

(1) Metal spraying emission factors for total chromium and nickel were developed from the results of several source tests in the AQMD and in San Diego County; the emission factors were in terms of mass pollutant per unit mass of pollutant sprayed.

(2) Although for hexavalent chromium was present in many of the source test samples, analytical techniques used were not as sensitive as they are today; the test data were not considered of sufficient quality to use for this inventory.

(3) MSDSs for the common powders or wire used for metal spraying showed chromium, nickel and zinc but no lead or cadmium.

7.1.2 Survey Response

(1) Responses were received from 1,814 (56 percent) of the 3,217 facilities surveyed; of these, 143 had data on metal welding, cutting and/or spraying operations.

(2) About 52 percent of the firms were eliminated from the emission inventory because they were not manufacturers or were manufacturers but did no welding, cutting or spraying.

(3) The overall response (including eliminated firms) had the same geographic distribution as the facilities to which surveys were mailed. However, the distribution of facilities that reported doing welding, cutting or spraying was higher than expected in Riverside and San Bernardino counties and lower than expected in Los Angeles and Orange counties.

(4) About 82 percent of the responses with emission inventory data were from fabricated metal products and industrial and commercial machinery manufacturers.

7.1.3 Metal Welding Inventory

(1) Eleven types of welding were reported at 138 facilities. The most common types of welding reported were gas metal arc welding (GMAW or MIG) (58%), gas tungsten arc welding (GTAW or TIG) (41%), and shielded metal arc welding (SMAW) (35%).

(2) Estimated 95-percent confidence intervals about the likely number of facilities in the AQMD using each welding processes are: 225 – 384 for GMAW, 210 – 377 for GTAW, 131 – 249 for SMAW, and 63 – 174 for fluxed cored arc welding (FCAW). The estimated likely number of facilities using other welding types ranged from 3 for electroslag welding to 93 for resistance welding.

(3) The annual AQMD-wide consumption of electrode is 1.5 million pounds. GMAW (MIG), FCAW, SMAW and GTAW (TIG) account for 87 percent of this consumption.

(4) The per facility average electrode usage ranges from 468 lb/yr (GTAW) to 5,700 lb/yr (FCAW).

(5) For six of the eleven welding types, over 90 percent of the welding is performed on mild steel.

(6) GTAW and laser welding are common on aluminum. Plasma arc is the only technique used on copper. Plasma arc and laser welding is most common for nickel substrate. Stainless steel utilizes oxyfuel, gas tungsten arc, and laser welding.

(7) Metal welding in the AQMD in SIC codes 3310 – 3869 generates uncontrolled emissions of about 115 lb/yr of total chromium, 33 lb/yr of lead, 60 lb/yr of nickel, and

337 lb/yr of zinc. Hexavalent chromium emissions are estimated to be about 10 to 97 lb/yr.

(8) All the lead emissions are from SMAW. SMAW is also responsible for almost all the zinc emissions and slightly over half the total chromium emissions.

7.1.4 Metal Cutting Inventory

(1) Seven types of high temperature metal cutting were reported at 75 facilities.

(2) The most common types of cutting are oxyacetylene cutting (OXY), plasma arc (PAC) and air carbon arc (CAC-A). These were reported by 52, 49 and 21 percent, respectively, of the facilities that reported doing high temperature metal cutting.

(3) Estimated 95-percent confidence intervals about the likely number of facilities in the AQMD using the major cutting processes are: are: 100 – 208 for OXY, 88 – 195 for PAC and 37 – 105 for CAC-A.

(4) For four of the seven cutting types (oxygen arc, carbon arc, PAC and OXY), over 80 percent of the cutting is performed on mild steel. CAC-A is used primarily on mild and stainless steel. Laser cutting is performed on mild and stainless steel and aluminum.

(5) Metal cutting in the AQMD in SIC codes 3310 – 3869 generates uncontrolled emissions of about 140 lb/yr of total chromium, 3 lb/yr of nickel and 20 lb/yr of zinc. The total chromium value is uncertain because it is based upon the results of a single source test.

(6) PAC is responsible for most of the chromium emissions from metal cutting. CAC-A, PAC and OXY represent most of the nickel and zinc emissions.

7.1.5 Metal Spraying Inventory

(1) Fourteen types of metal spraying formulas were reported by six companies. All contained at least one of the toxic metals chromium, nickel or zinc. None reported lead or cadmium.

(2) Three companies sprayed some chromium metal, three companies sprayed some nickel metal; two companies sprayed zinc metal only.

(3) Emissions from three companies showed 5.0 lb/yr of nickel and 44 lb/yr of total chromium.

(4) Two companies sprayed substantial amounts of zinc but no emission factor was available to estimate emissions.

7.1.6 Effect of Emission Controls

(1) Only nine of 143 survey respondents reported use of air pollution control equipment.

(2) Fabric filters, baghouses or HEPA filters were used to control particulate matter at eight of the nine companies which reported use of control equipment.

(3) The reported control equipment would have little impact on AQMD-wide absolute zinc and lead emission estimates.

(4) For welding processes, the reported control equipment is estimated to reduce total chromium emissions by about 41 percent and nickel emissions by about 10 percent.

(5) For cutting processes, the reported control equipment is estimated to reduce total chromium, nickel and zinc emissions by 29, 22 and 21 percent, respectively.

7.2 RECOMMENDATIONS

The contractor recommends the following.

7.2.1 Better Characterization of Emissions

As was discussed in Chapter 2, many of the emission factors are based on very little factual data and are of uncertain validity. It was beyond the scope of this project to conduct emissions tests to develop new or alternative emission factors, so published data were used with some caveats.

Given the dearth of data on the emission factors and the questionable reliability of MSDSs, any emission calculations and/or risk assessments conducted for individual facilities could be improved by use of better factors. The contractor therefore recommends that the AQMD conduct or sponsor a focused program of emission factor development tests at representative manufacturing facilities which utilize chromium containing electrodes or substrates. At the same time, analyses should be conducted for nickel, zinc, lead and cadmium.

7.2.2 Investigation of Control Techniques

The study did not find air pollution controls being used for many metal welding or cutting operations. Metal spraying is controlled more often with HEPA filters. The emissions inventory indicates that metal welding and cutting could contribute a significant amount of total chromium emissions, at least some of which may be in the form of hexavalent chromium. To reduce these emissions, control techniques for these processes should be investigated. Such investigations should include a more detailed study and quantification of emissions from some of the larger sources in the AQMD. Any controls that are used elsewhere in the country at such facilities as large assembly parts with robotized welding operations should be identified. Another area of investigation would be alternatives for the electrodes or welding techniques having the highest emission factors.