METAL MELTING AND CASTING OPERATIONS

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PROCESS DESCRIPTION:

Actual processing of raw ores and scrap metal for purification purposes is not common in San Diego County. Most "smelting" and "foundry" activities currently in San Diego County are actually melting and casting operations using relatively pure metal ingots. Local facilities employ relatively small crucible and pot furnaces to melt ingots prior to casting into dies and molds for small parts, tools, and plaques. Some particulates, alloy additives, flux, and trace metal contaminants from both the melting pot and the casting area are emitted into the air.

Emission factors for primary and secondary smelters are published in Sections 12.1 through 12.14 of AP-42 (1/95). Most of these values are not applicable to San Diego County metal working operations. Previous District permitting work produced some local test data for Kirksite and lead processes. AB2588 testing was performed in 1990 at a few local Phase 1 facilities with metal melting and casting processes involving aluminum, cast iron, brass, yellow brass, bronze, inconel, monel, nickel, steel, and stainless steel. These tests generally produced unreliable results due to difficulties collecting all process emissions in existing stack ducting, the build up of previous particulate emissions in sampled exhaust stacks, small sample sizes, inconsistent sampling techniques, and variable process operating conditions. District staff has observed significant differences in melting rates, operating temperatures, charge compositions, holding times, mold sizes, stack ducting, and operator techniques. All of these operating parameters probably affect emission rates.

Based on currently available information, charge weights and charge composition are the only feasible process information on which to develop emission factors. In general, the existing emission factors published in Table 12.14-2 of AP-42 for kettle pot melting and casting will be used by the District. The composition of particulate emissions will be assumed equivalent to the charged materials unless otherwise specified. Emissions and control efficiencies will be calculated separately for the melting and casting operations.

Estimation methods used by the District for metal melting pots are as follows;

$$\mathbf{Ea = ([Ua \times EF_m \times (1 - e_m)] + [Ua \times EF_c \times (1 - e_c)]) \times Ci}$$

$$\mathbf{Eh = ([Uh \times EF_m \times (1 - e_m)] + [Uh \times EF_c \times (1 - e_c)]) \times Ci}$$

Where:

Ea = Annual emissions of each listed substance, (lbs/year)

Eh = Maximum hourly emissions of each listed substance, (lbs/hour)

Ua = Annual charge weight of each material to the melting pot, (tons/year)

Uh = Maximum single charge to the melting pot, (tons/hour)

EF_m = Melting pot emission factor for each charged material, (lbs PM10/ton charged)

EF_c = Casting area emission factor for each charged material, (lbs PM10/ton charged)

Ci = Concentration of each listed substance in the particulate emissions, (lbs/lb)

e_m = Melting pot control equipment collection and removal efficiency, (%)

e_c = Casting area control equipment collection and removal efficiency, (%)

EMISSIONS INFORMATION:

Studies and stack test data from both ferrous and nonferrous smelters and foundries indicate a wide variety of emission rates and compositions. A clear correlation could not be established between emission rates and process rate or charge compositions. Melting pots are usually partially ducted and occasionally equipped with control devices. Casting areas are typically uncontrolled. Materials are often recharged into facility melting pots several times throughout a given reporting period. Operating records should therefore be used to estimate annual and maximum hourly charge weights rather than purchase or inventory information.

AP-42 contains melting and casting emission factors based upon charge weight for secondary lead and zinc processing. The AP-42 emission factors used by the District are from Section 12.11 (1/95) for lead processes and Section 12.14 for zinc, kirksite, and other metal melting processes. Particulate emission speciation information for kirksite operations is from Rohr AB2588 test results. Lead pot particulate speciations are based on AP-42 factors in Table 12.11-2. Emissions for other processes will be assumed equivalent to the charge compositions until additional test data becomes available. The following emission factors and speciation profiles are currently used by the District;

Particulate (PM10) Emission Factors

Emission Factors	Lead processes	Kirksite processes	Other processes
Melting (lbs/ton charged)	0.03	0.01	0.01
Casting (lbs/ton charged)	0.04	0.03	0.03

Emissions Speciation Profiles

% Composition	Lead processes	Kirksite processes	Other processes
Aluminum	no data	no data	no data
Barium	no data	1%	no data
Cadmium	no data	1%	no data
Chromium	no data	7%	no data
Copper	no data	6%	no data
Lead	30%	3%	no data
Manganese	no data	16%	no data
Nickel	no data	no data	no data
Thallium	no data	57%	no data
Zinc	no data	9%	no data
Other	70%	no data	no data
Equivalent to Charged Material	NA	NA	100%

Historically, the source testing of lead melting pots has produced widely varying results with poor reproducibility. AB2588 source testing was performed at the USN North Island facility but the results were unacceptable because the testing firm used unapproved sampling equipment and techniques. Retesting at USN North Island was not possible due to a PCB spill in the foundry area after the first test. District particulate testing performed on a lead melting pot in 1977 at the General Dynamics Convair Division (Test No. 303) produced results an order of magnitude higher than the AP-42 factors. Three test samples collected at Rohr yielded lead melting pot emissions of 0.0179, 0.0016, and 0.0023 lbs. lead / ton charged.

Testing of Kirksite operations has also been inconclusive. Preliminary findings of a 1991 ARB investigation of ferrous and non-ferrous smelters / foundries indicate a wide variety of process equipment, charge materials, operating procedures, operating temperatures, control equipment, and emission rates. Obtaining accurate and reproducible emission factors may not be possible since each device might release trace air contaminants over a wide range of emission rates dependent upon many of the variable process and operating conditions. The use of "average" emission factors and control efficiencies appears to be the most reasonable approach available at this time.

ASSUMPTIONS / LIMITATIONS:

- While site specific test data approved by the District may be used in place of default factors, speciation profiles, and/or control efficiencies, average data over a variety of conditions may be more representative of annual emissions than a single test result. All particulate emissions from metal melting and casting operations are assumed to be PM10.

- Charge weights should be based upon operating records not purchase information or inventory adjustments since large quantities of materials are often recycled at each facility.

- Operating parameters that may significantly affect emissions and test results from a particular device include work area dust, ducting configuration, soot, freeboard ratio, pot size, operating temperature, volatile trace metal contaminants, additives, holding time, agitation, casting technique, quantity of material poured, metal vapor particle size, control equipment collection efficiencies, and control equipment removal efficiencies.

- Emissions of hexavalent chromium are assumed to be 10% of all chromium emissions unless otherwise approved.

- Emissions from combustion processes that heat the melting pots are assumed to be negligible but may be quantified using the fuel combustion procedures.

- Control equipment is assumed to be equally effective regardless of particle size or type of material. However, overall process control efficiencies must be adjusted to account for fugitive emissions not collected by the site specific ducting.

- The composition of emissions from Kirksite operations should be assumed equivalent to the compositions detected in Rohr stack tests until more accurate information is obtained.

- The composition of emissions from lead operations should be assumed equivalent to AP-42 information (0.02 lbs/lead per 0.07 lbs particulate; 30%) until more accurate information is obtained.

- The District has received unreliable information regarding emissions from other ferrous and nonferrous processes. Particulate emission rates should be assumed equivalent to Kirksite processes and particulate compositions should be assumed equivalent to the charged material's composition until more accurate information is obtained.

FORMS:

An Emissions Inventory form must be completed for EACH material charged to each melting pot on site. The casting area is considered part of the device for reporting purposes but may require special consideration for emission modeling.