FUME CONTROL—ELECTRIC MELTING FURNACES

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THE SERIOUS EFFORT of Los Angeles County to clear its smog conditions has made that area a proving ground for control methods and for air cleaning equipment. Studies for many processes have indicated amount of contaminant released, its nature and particle size. Pilot plant installations have demonstrated the degree of control that can be expected at economical first cost, and with reasonable operating and maintenance expense.

The fumes from electric melting furnaces in the steel foundry industry present a typical history of how such problems can be investigated and solved. During the melting cycle varying quantities of fumes are released, with the concentration visually heavier during the early melt-down period and during the boil and refining portion of the cycle. Fume concentration will also be a function of the scrap charged, with the more heavily oxidized and the oilier materials producing the greater concentrations.

Fumes are released from around the electrodes, the charging door and the pouring spout, escaping to the melting room as shown in Fig. 1. Exhaust ventilation by propeller fans in the roof monitors has been accepted practice of keeping the fumes from filling the foundry working area. Exhaust volumes of 60,000 to 100,000 cfm to induce the discharge of these products to the atmosphere have been common.

Installation of collection equipment for exhaust volumes of this magnitude would involve prohibitive equipment cost and high operating expenditures. It became apparent that some system whereby fumes were confined to smaller exhaust volumes would be necessary to make fume collection practical.

*Chief Engineer, Dust Control Div., and Los Angeles representative, respectively.

[1] J. M. Kane, "The Application of Local Exhaust Ventilation to Electric Melting Furnaces," A.F.S. TRANSACTIONS, vol. 52, pp. 1351-1356 (1944).

Such a system employing local exhaust ventilation principles had been developed[1] and introduced to foundry practice in 1937, primarily to provide more positive fume removal from the melting room and better visibility for the crane operator. Such a hood is attached to the furnace roof ring, exhausting the fumes at the points of generation (Figs. 2 and 3). Exhaust volumes can be reduced to 10 to 15 per cent of the volumes required by general ventilation methods.

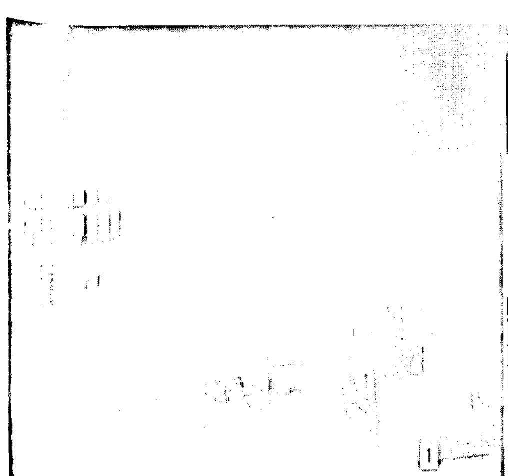
The furnace tested in the Los Angeles investigation was a 3-ton, side-charge, acid furnace operated on a 2-hr cycle with charges of approximately 7500 lb. Test No. 2 used heavily oxidized scrap from the bottom of the scrap pile and represents the heavier loadings that could be expected under poorer scrap conditions. Furnace was equipped with hood exhausting fumes from charging door and around electrodes. Pouring spout was plugged so that no escapement occurred at this point.

Essential data from four tests conducted during four complete 2-hr melting cycles are tabulated in Table 1. Dust loadings in exhaust gases varied with the point in the melting cycle, with the heaviest loading occurring during the boil and refining cycle. Variation in loadings of the above four tests are shown in Fig. 4.

Samples taken periodically during the test runs were checked with the electron microscope, and it was indicated that approximately 95 per cent of all particles were less than 0.5 microns, with practically no particles above 2 microns. Agglomerating tendency of the material, however, was pronounced.

A local exhaust wet type dust collector was installed

Fig. 1—Typical smoke and fume release from steel foundry electric melting furnace. Fig. 2—Fumes are confined by local exhaust hoods on roof ring and exhausted material removed by wet type dust collector located, in this instance, on transformer room roof. Fig. 3—Spring loaded flange joint in exhaust duct allows furnace to tilt for pouring or slagging operations.


(1)


(2)

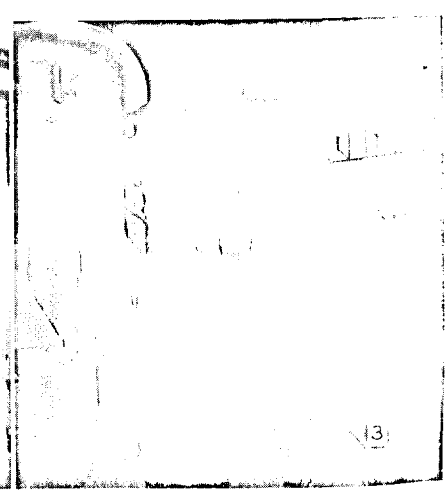

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Table 1—Solids in Electric Furnace Gases

Test No.	1	2	3	4
Charge, lb	7471	7557	6559	7462
Solids in stack, gases, lb	16.0	28.4	19.1	21.4
Solids/ton charged, lb	4.5	7.5	5.8	5.7

for the two 3-ton furnaces, one acid and the other basic, and guaranteed to meet solids removal requirements of the Air Pollution Control Board. (With a process weight of 3750 lb/hr/furnace, maximum permissible escapement would be 5.77 lb/hr for one furnace in operation; 8.39 lb/hr for both furnaces.)

Test data during a 97-min period, including the boil and refining periods of both furnaces, indicated a loss from the exhaust system discharge of 3.35 lb/hr as compared with an allowable 8.39 lb/hr. Collection efficiency of a dust collector is defined as the ratio of the weight of material collected to the weight of a material entering the exhaust system, and can be calculated from the above data.

Average loading from one furnace during the earlier tests 1, 3, and 4 was approximately 9 lb/hr, which translated to the "on" time of both furnaces during 97-min test period would equal a total loss of 21 lb. Reduction of this loss to 5.59 lb for the test period indicated a probable local exhaust collection efficiency of 73 per cent.

To verify above conclusions, simultaneous sampling at inlet and discharge of exhaust system was made during an 81-min test. The basic furnace contained a 5300-lb charge of manganese steel, and the acid furnace a 5000-lb charge of carbon steel. Boil and refining periods for both furnaces were included in the tests run.

Data and results obtained during this test are shown

Table 2—Test Data for Local Exhaust System

	Exhaust Inlet	Exhaust Outlet
Duration of test, min	81	81
Flow volume through duct, cu ft	695,500	689,000
Volume sampled, cu ft	231	262
Weight material collected, grams	1.613	0.506
Concentration, lb/hr	8.6	2.35

$$\text{Efficiency} = \frac{8.6 - 2.35}{8.6} = 72.7\%$$

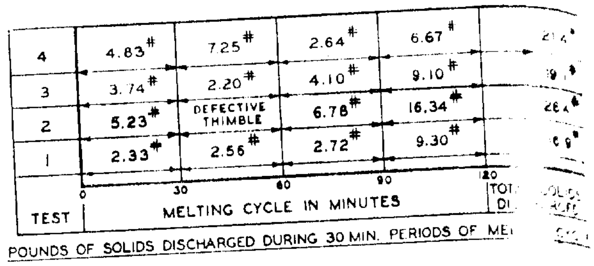


Fig. 4—Variations in dust loadings of the

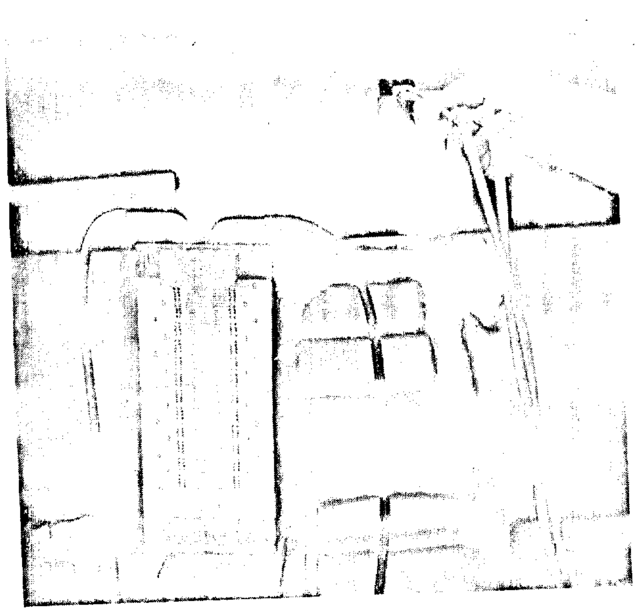
in Table 2. This efficiency of 72.7 per cent estimates on effectiveness of exhaust system from previous test data.

Much of the data was obtained by the Ste[illegible] ers' Society committee through the active as[illegible] Alloy Steel and Metals Co., Los Angeles, an[illegible] Francis of that company. Collection efficiency[illegible] loadings were then checked at a Midwest steel[illegible] During the two test periods reported in Table[illegible] top-charge furnace was melting 12,000-lb charges produce SAE 1045 or 1025 steel.

Sampling equipment (Fig. 5) consisted of[illegible] sampling tubes located in the inlet and outlet du[illegible] of the exhaust system. The velocity and volume[illegible] gases in the ducts at the sampling points were de[illegible] mined by pitot tube traverses (Fig. 6). Samples we[illegible] pulled through the tubes simultaneously at veloc[illegible] approximately equal to the velocities in the ducts approximately by means of a vacuum pump or compressed air opera[illegible] Hancock ejectors. The samples passed through Wh[illegible] man extraction thimbles which act as absolute fil[illegible] to remove all entrained solids.

These thimbles were dried to constant weight befo[illegible] and after each test, and the difference in weight w[illegible] the material collected at each sampling point. I[illegible]

Fig. 5 (below, left)—Equipment used for measu[illegible] velocity and volume of duct gases. Fig. 6 (belo[illegible] Sampling equipment employed in the tests includ[illegible] (A) Whatman extraction thimble; (B) means[illegible] measuring volume of gas sampled; (C) vacuum pu[illegible]



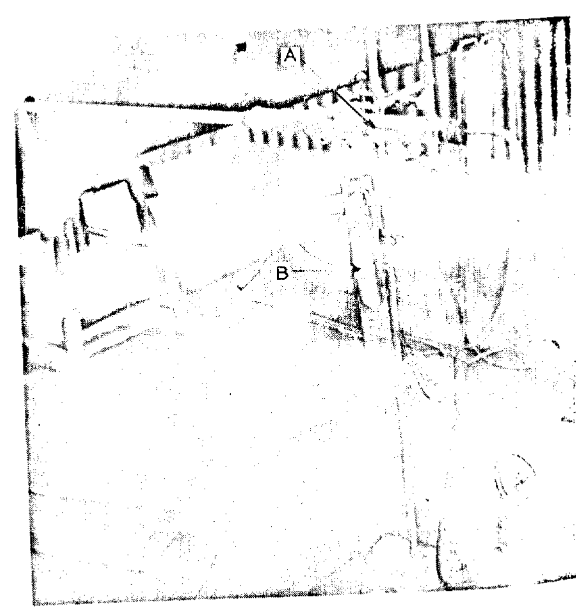


TABLE 3—TEST DATA FROM 6-TON CHARGES IN ELECTRIC MELTING FURNACE

	Test No. 1		Test No. 2	
	Inlet	Outlet	Inlet	Outlet
..ration of test, min..	140	140	120	120
..s volume through ..act, cu ft..........	1,820,000	1,820,000	1,680,000	1,680,000
..lume sampled, ..u ft	83.4	112.1	70.5	99.0
..g loading during ..omplete melting ..cle, grains/cu ft..	0.356	0.08	0.346	0.065
..ds during melting ..cle, lb/ton charged	15.3	3.46	12.75	2.42
..iciency, %		77.6		81.2

..lume of gas sampled was determined for each tube .. observing the pressure drop across a calibrated ..ifice located in the sampling kits after the extraction ..imbles. By knowing the volume of gas sampled, the ..lume of gas handled and weight of entrained solids ..llected, the total weight of entrained solids entering ..nd leaving the exhaust system was determined as ..ven in Tables 2 and 3.

Gage of discharge density by the Ringleman Chart method does not lend itself to accurate readings, as would be expected of this method designed as a gage for smoke density from coal burning gases of combustion. Densities of the order of No. 2 Ringleman or more (50 per cent obstruction to the passage of light) occur without dust control equipment; densities under No. 1 Ringleman (20 per cent obstruction to the passage of light) were obtained at all times with the local exhaust system in operation.

Conclusion

From this study, emission of solids of the order of 5 to 8 lb/hr/ton of metal melted can be expected from electric melting furnaces in steel foundries. Particle size of solids, primarily ferric and ferrous oxides with some silicon dioxide, are 95 per cent less than 0.5 microns.

Reduction of this quantity by about 75 per cent can be obtained with good wet dust collection equipment. With the confinement of escaping solids from the furnace through local exhaust ventilation methods, total exhaust volumes can be reduced to quantities making cost of collection equipment feasible.

NATIONAL DEFENSE THEME OF FEMA MEETING

MOBILIZATION, government controls and current ..siness conditions as they affect the foundry and ..ndry equipment industries were dominant themes .. the 32nd Annual Meeting of the Foundry Equip..nt Manufacturers' Association, held October 12-14 .. the Greenbrier, White Sulphur Springs, W. Va.

Highlights of the three-day meeting were a sympo..um on mobilization and the Washington scene, an ..en forum on the status of the foundry equipment ..dustry, and election of officers for 1950-51. Lunch..ns, an annual banquet, president's reception and ..lf tournament were social features of the meeting.

Officers of the Association elected for 1950-51 were: *..esident,* C. V. Nass, Pettibone Mulliken Corp., Chi..go; *vice-president,* Aubrey J. Grindle, Whiting ..rp., Harvey, Ill.; *executive secretary and treasurer (re-elected),* Arthur J. Tuscany. *Directors to serve three-..ar periods:* Wayne Belden, Ajax Flexible Coupling .. Inc., Westfield, N. Y.; E. A. Borch, National Metal ..rasive Co., Cleveland; and Leon Miller, Osborn ..fg. C.. Cleveland.

Op.. ..g the meeting on Thursday morning, Octo.. 12, ..ere product group sessions on Policy, Mold.. M..ines, Dust & Fume Control, Flask Manu..tur.. ..last Cleaning & Tumbling; Furnace, Cupola ..d I..e; and Material Handling and Processing. ..rid.. sessions opened with words of welcome ..m I..iring FEMA President John Hellstrom and ..MA ..xecutive Secretary-Treasurer Arthur J. Tus..ny. P..cipal feature of the day was a *"Symposium—.. W..ington Picture,"* with Thomas Kaveny, Jr., ..sidi.. and F. G. Steinebach, Penton Publishing .. Cleveland, reporting on *"Developments in the ..shington Scene."* L. C. Wilson of Reading, Pa., ..lined *"Pertinent Facts on Mobilization of the ..undry Equipment Industry."*

Following this, A. F. S. National President Walton Woody spoke on such *"Subjects of Joint Interest"* to both the American Foundrymen's Society and FEMA as the A.F.S. long-range, industry-wide Safety, Hygiene and Air Pollution program and the A.F.S. campaign for a permanent American Foundrymen's Society Headquarters.

Final sessions of the three-day meeting, held Saturday morning, October 14, opened with an *"Interpretation of FEMA Business Trend Reports"* by Chairman E. A. Borch of the Statistical Committee. Highlight of the program was an open forum on *"Rate of Activity in the Foundry Equipment Industry,"* with FEMA President-Elect C. V. Nass reporting on activities of the National Castings Council.

Non-Ferrous Casting Tonnage Up 30 Per Cent: NFFS Annual Meet Told

SUBSTANTIAL INCREASE in demand for both copper-based and aluminum based alloys was reported at the Annual Meeting of the Non-Ferrous Founders' Society, held in Boston on October 13, 14 and 15.

The nationwide pattern shows a casting tonnage increase of from 30 to 35 per cent over last year, apparently caused by demands for defense contracts.

A discussion of the role of trade associations in the nation's defense program by Lieut. Commander Clarence Cisin was a meeting highlight. Other topics discussed were present and future government controls and NFFS's proposed presentation of complete industry cost controls in keeping with government directives and control orders.

Newly-elected officers are: *president,* J. D. Zaiser, Ampco Metals, Inc., Milwaukee; *vice-president,* W. H. Durdin, Dixie Bronze Co., Birmingham; *2nd vice-president,* Robert Langsenkamp, Langsenkamp, Wheeler Brass Works, Indianapolis. New directors are Raymond E. Bietry, B & S Foundry, Brooklyn; Mr. Langsenkamp, and L. G. Smith, Lakeside Bronze, Inc.