Observations Made At The American Crucible Products Company's Plant at Lorain, Ohio

Conditions existing in the operation of the furnace, casting and cleaning rooms of the plant of The American Crucible Products Company at Lorain, Ohio were observed on February 9. Particular attention was paid to operations having potential health hazards because of the presence of lead fumes and dusts of lead compounds in the atmosphere. These operations were examined in a cursory manner by the analysis of particulate material collected from the atmosphere by means of a filter-paper technique.

The filter-paper technique, rather than the more reliable electrostatic precipitation of particles from the air, was used because the former was the more convenient and satisfactory for obtaining preliminary information concerning the conditions at the plant. It should be borne in mind that the data so obtained during this visit are merely illustrative rather than representative of the average or regular conditions of exposure to lead.

Procedure

The equipment used to collect samples from the atmosphere consisted of an aluminum cone in which two Whatman #40 filter papers could be placed so as to expose a surface area of about 11 cm. in diameter to a stream of air. Suction to draw the air through the papers was

provided by the pump of a small equipment designed for field use. One cubic foot of air per minute can be drawn through the apparatus when the crank of the pump is rotated at the rate of approximately 45 rpm. The volume of air sampled was determined from the total number of revolutions of the crank and a calibration chart which related revolutions per minute to revolutions per cu. ft.

The lead determinations were made by means of a colorimetric method which is based on the use of dithizone under conditions which ensure specificity for lead.

Results and Discussion

The quantities of lead removed from the air in the vicinity of the various operations which were studied are listed in Table 1. It is apparent from the data that definite conclusions concerning variations in the lead concentration which may arise from variations in the movement of the air in the several areas of the plant (variations in state of windows, etc.) cannot be determined from tests made on any single day. Moreover fortuitous or changing factors such as differences in the operations and in the production schedules must also be considered in the total picture. Variations in any one of these factors may be sufficient to account for the small differences observed between the two series of samples

taken on February 9.

The data demonstrate the occurrence of excessive concentrations of lead in the air in the vicinity of all of the operations which were studied. (Values far in excess of 1.5 mg. of lead (Pb) per 10 M³, should not be permitted to exist in the atmosphere of working establishments for more than a few minutes at a time, and the average value daily should not exceed this figure.) In the case of the foundry, air is drawn into the area through doors and windows by fans set in bays in the ceiling of the foundry. It is a well established fact that such general ventilation is often found to be unsatisfactory for the removal of toxic dusts and fumes by dilution, principally because excessive volumes of air must be used even when the atmosphere is only moderately contaminated. Local exhaust ventilation systems, so applied as to capture fume and dust at their points of origin are much more economical and effective. One of the difficulties of the general ventilation of this foundry is that the air moves through and away from most of the working stations toward the ceiling, generally passing through the breathing zone of the worker who frequently must stand or bend directly over his work. This is particularly true of the "unit shakeout", where the highest concentrations of lead were found. Another location at which an excessive lead concentration was found was at the "core knockout", where again, the

operator stands directly over his work while dust and fume move through his breathing zone to the fan in the roof.

The concentration of lead in the air near the cut-off machine in the cleaning area is also excessive. Inspection of the entire cleaning area indicated that the housekeeping in this area is poor, there being piles of filings and dust on the equipment as well as on the floor. Some of the abrasive wheel cleaners in this area are adequately exhausted, but much grinding of small objects is carried on without the aid of local exhaust ventilation at a large table in the center of the room. Since the alloys handled in this room are probably all of the same type it is logical to expect that the concentration of lead in the atmosphere in the entire area would not differ too much from that found near the gate cut-off machine. The latter machine is locally exhausted but apparently ineffectually. Part of the difficulty is due to the fact that the suction opening is at least 18 inches from the cutting edge of the wheel and the velocity of the air at the wheel itself is too low to capture the dust which is generated there.

The conditions with respect to lead exposure existing at the plant during this visit are similar to those noted by Dr. R. A. Kehoe in a survey made in 1943. A memorandum containing recommendations for improving

conditions was submitted by Dr. Kehoe on May 19, 1943, but apparently these recommendations have not been followed out to a sufficient extent to correct the conditions described.

Recommendations

In view of the observations and air studies reported above, it is suggested that the recommendations made by Dr. Kehoe in the memorandum of May 19, 1943, be followed as completely as possible. As suggested then, attention should be given to the use of adequate and well designed local exhaust ventilation, particularly at the points indicated below.

1. The unit shakeout should be locally ventilated so that fumes are moved away from the breathing zone of the worker. Fume should be exhausted both laterally and by downdraft.

2. The site of the core knockout operation should be ventilated in a manner similar to that recommended for the shakeout operation.

3. The ventilation of the gate cut-off machine should be improved by moving the exhaust opening closer to the cutting edge of the wheel, or preferably by using downdraft ventilation at the adjustable table of the machine.

4. Downdraft local exhaust ventilation should be furnished to the stations on the large table where small castings are cleaned.

5. Air exhausted and laden with lead compounds should be discharged in such manner as not to be a further source of contamination within the plant, and so as not to pollute the air in the vicinity of the plant.

6. Where general room ventilation must be used, the air drawn in in winter should be pre-heated so that workers will not close doors and windows during extremely cold weather.

The only alternative to the application of the foregoing measures at all of the sites indicated is that of the use of properly designed and maintained air line hose masks in connection with certain specified jobs of short duration. Since such jobs do not appear to fit into the picture of the plant operations, this alternative, which at best is a makeshift, is not regarded as feasible.

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Table 1

Concentrations of Lead in the Atmosphere of the Furnace, Foundry and Cleaning Rooms of the American Crucible Products Company at Lorain, Ohio

Analysis Number	Location and Description	Start	Cu. Ft. Sampled	Mg. Pb. Found	Mg. Pb. per 10 M³
51A-1003	In furnace room, fans on, doors and windows open (#1)	11:05 A.M.	4.2	0.0033	0.28
51A-1008	In furnace room, fans on, doors and windows closed (#6)	1:20 P.M.	4.85	0.083	6.1
51A-1004	While skimming and stirring pot (7% Pb) fans on, windows and doors open (#2)	11:21 A.M.	1.02	0.011	3.8
51A-1009	While skimming and stirring pot (14.5-15.5% Pb) fans on, windows and doors closed (#7)	1:35 P.M.	1.32	0.011	3.0
51A-1005	While moving metal and casting at far end of foundry and return to furnace room (14.5-15.5% Pb) fans on, windows and doors open (#3)	11:30 P.M.	4.9	0.073	5.3
51A-1006	While moving metal and casting at far end of foundry and return to furnace room (14.5-15.5% Pb) fans on, windows and doors open (with charcoal cover) (#4)	12:50 P.M.	4.85	0.016	1.2
51A-1010	While moving metal and casting at far end of foundry and return to furnace room (14.5-15.5% Pb) fans on, windows and doors closed (#8)	1:45 P.M.	7.05	0.058	2.9

Table 1 (continued)

Analysis Number	Location and description	Start	Cu. ft. sampled	mg. Pb. found	mg. Pb. per 10 M³
51A-1007	At Unit Shakeout, fans on, windows and doors open (#5)	1:05 P.M.	4.05	0.059	5.2
51A-1011	At Unit Shakeout, fans on, windows and doors closed (#9)	2:00 P.M.	1.3	0.107	29.0
51A-1015	In aisle of foundry, during normal operation, fans on, windows and doors open (#13)	2:55 P.M.	4.5	0.030	2.35
51A-1012	In aisle of foundry, during normal operation, fans on, windows and doors closed (#10)	2:10 P.M.	4.8	0.019	1.4
51A-1013	In cleaning room at cut-off machine, cutting gates (14.5-15.5% Pb) (#11)	2:20 P.M.	3.14	0.03	3.4
51A-1014	Core knockout (14.5-15.5% Pb) (#12)	2:45 P.M.	2.00	0.015	2.55