REPORT AND RECOMMENDATIONS RELATING TO THE OPERATIONS IN THE PLANT OF THE AMERICAN CRUCIBLE PRODUCTS COMPANY, LORAIN, OHIO

Shake Out

Ideally this operation is carried out mechanically in a totally enclosed ventilated hood in which case the operator has no exposure. This ideal situation is rarely entirely practical from an operating standpoint, since, generally, residual sand must be knocked off from the castings by hand. However, since the amount of dust which will be liberated during the shake-out depends to a considerable extent on the amount present, the next best arrangement is that of a combination operation, in which the bulk of the sand is removed mechanically in a totally enclosed ventilated hood and the remainder removed by hand in a hood which develops positive suction at the face of the operator. It is possible safely to carry out the entire operation by hand providing sufficient lateral air movement can be maintained away from the operator and toward the emptied flask. This requires strong down draft through the grating and a lateral air-gathering hood on the far side and over the shake-out, as per sketch A. If it is necessary to have access to the flasks from two sides, it is also necessary to have very strong downdraft through the grates and very strong updraft through an overhanging canopy hood suspended over the shake-out area. This arrangement requires huge quantities of air and is none too good at best. In our opinion, the operational requirements at this plant do not require this compromise. We recommend as first choice the totally enclosed station followed by the laterally ventilated hand shake-out station as per sketch A, or, as second choice, the laterally ventilated station alone with access from one side only.

Grinding, Chipping, Sawing operations

All grinding, chipping and sawing operations should be vented in such a manner as to gather the material as soon as possible at the point of origin. In general, this requires air velocities of not less than 300 feet per minute at the inlet over a sufficient area to insure efficient collection of the particles. The hooding should be so located that the particles given off are drawn directly into the opening. An horizontal arrangement of the exhaust at the side on to the rear is generally most effective. Reference is made to Industrial Health Engineering (Brandt) for details of design applicable to such operations. Since ventilation requirements for this type of equipment depends on the nature of the material being handled, and since there is generally some sacrifice of flexibility of operation in order to provide adequate ventilation when lead or other potentially toxic materials are being handled, manufacturers in general do not provide adequate protective equipment for handling such materials. It is then necessary to "custom design" the equipment and by trial and error arrive at the optimum design for each machine and operation. It is wise, therefore, in estimating the ventilation requirements to overdesign in order to have sufficient capacity for the trial and error experimentation. Ducting should be designed for a particular machine or group of machines to permit proper ventilation with all machines running. Once balanced other machines should not be tied in to the common duct without making sure such addition has not changed the efficiency of ventilation of the original machines. A velometer should be used to check the air flow at and near the intake, and such checks should be repeated on a regular schedule to insure continued efficient operation.

Sand Blast and Wheel Abrader Operations

The sand blast room should be totally enclosed and ventilated and, of course, protective equipment supplied to the operator. Discharge should be collected in a system which is designed (and tested) so as not to leak into the interior of the building. Exhaust after collection should be discharged to the outside in such manner that it cannot be returned into the building.

Wheel abraders generally are not absolutely tight and experience has shown that more than just normal ventilation is required. We recommend, therefore, that this equipment be located near a positive exhaust fan of sufficient capacity to keep positive air movement from a clean area to the abraders. Air sampling tests will be required to establish the amount of air movement necessary and to check on the tightness of the machine. The vent, of course, must be discharged to the outside.

Large Core Knock-out

Down and lateral draft ventilation concentrated near the knock-out level should be adequate for this operation. The hood design can be similar to the shake-out hood with the grate at floor level and the hood structure elevated.

Pouring Stations

Consideration should be given to a lateral draft slotted and overhead hood at the "permanent" pouring stations. The overhead general ventilation should be retained, but it is a reasonable expectation that the lateral and overhead hoods will perform more efficiently with the general overhead ventilation reduced.

Pouring of the larger castings should either be done under a hood of sufficient capacity to prevent general diffusion of the fumes, or a suitable portable flexible tube exhauster should be

provided to collect the fume at the source (Cooper type exhausters would probably be suitable.) The use of a ventilated pouring ladle (to be described below) might make it unnecessary to consider these suggestions, in which case the general exhaust fans would be retained at present or at reduced capacity.

Portable Hood for Pouring Ladle

It has been recognized for some time that some method is needed to reduce or control the fumes from the molten material in the ladle from the time the ladle is charged until all of the material is poured from it. Probably the most concentrated exposure to workmen occurs during the period during which the ladle is being transferred from the furnace room to the pouring station. During this time the fume is also being diffused throughout the plant. The use of the portable hood reported in Bulletin No. 7, February 1947 of the Kentucky Department of Health recognizes the hazard during the pouring operation, but it is not clear how the fumes are carried away during transportation unless the pouring station is adjacent to the furnaces. Sketch C illustrates a ladle carrier with ladle ventilation and fume filter. In principle it fulfills the requirements, but it obviously will require development under actual operating conditions. With the arrangement a trolly will be necessary to run the blower. The sketch shows a hydraulic lift system. Probably a mechanical worm gear control would be more acceptable. Experimentation will be necessary to determine the best type of filter, and this may be a problem because of the high temperatures to which such equipment will probably be exposed. We offer this idea for consideration for development and trial. It is quite possible that this could be done in cooperation with other industrial organizations that are presented with this, as yet, unsolved problem. It is clear that equipment which would meet

This situation properly would reduce materially the specific and general lead exposure and would diminish greatly the general ventilation otherwise required.

General Ventilation and Heating

In general, various operations which are not referred to specifically do not require separate ventilation but should have more than general comfort ventilation. It must be remembered that the molding sand contains particulate lead, and that excessive dust in association with the handling of the sand can produce an elevated lead concentration in the atmosphere. The overall air flow must be directed from clean areas to those of potentially high concentration and thence to the outside. Since whatever air is removed must be replaced with clean tempered air (in the winter) the inlet and outlet volumes must be reasonably balanced in order to attain the desired air flow as above described. For economic reasons short circuits which do not remove contaminants must be avoided. The overall problem of ventilation of this plant is complicated by the low roof construction which interferes greatly with the rapid dissipation of fumes. The heater exhaust must be more carefully considered in relation to the workmen and to general work areas because of the possibility of excess local hot air drafts near the exhaust and cold air nearby. This would not be true if the heater outlets could be high above floor levels. The installation of the proposed heaters should, however, make it possible to maintain more comfortable conditions and at the same time materially reduce the overall and local lead concentration during the winter months. Since a large amount of heat is liberated in the furnace room, a minimum amount of tempered air will be required for this room; hence the cold air intake in the design. The advisability of employing a velometer to measure air flow and to check on the airflow

at different seasons of the year cannot be overemphasized. All openings not normally intended as part of the ventilating system should be studied to determine if they are aiding or hindering the ventilation pattern. If they hinder, they must be kept closed and made difficult of opening. Cooling blowers of the type now in use on the floor in the furnace room, which generally churn up the air, should not be used unless tests show that their use in any particular situation does not interfere with the general desired ventilation pattern. A slowly and steadily moving mass of air is often more effective in carrying away contaminants than a faster moving gusty turbulent mass of air. The total existing fan capacity is many times the projected tempered air inlet capacity. If hooding as suggested accomplishes the ends intended, it is possible that much of the general ventilation can be reduced, thereby promoting a more comfortable working environment during the winter period.

Dusty Operations and Housekeeping

The foundry is somewhat overcrowded, and it is realized that under such conditions meticulous housekeeping is difficult. Nevertheless, because the stirring up of dust may be an important factor in the hazard, every reasonable effort should be made to keep the plant clean and, by the use of water and sweeping compound, to reduce dust to a minimum. Wafter dust should be removed periodically, not only to prevent its dissemination but to promote general interest in good housekeeping.

General Health

The recommendations made by Doctor Kehoe dated May 19, 1943 should be reviewed and to the extent that they are not being followed they should be put into effect. Ingestion of lead by eating a sandwich

on the job can contribute to sickness and neutralize safety measures based on the installation of elaborate ventilation equipment. Moreover this is an wholly unnecessary type of hazard which can be eliminated by educational and disciplinary means without costly equipment.

General

The recommendations contained herein, which are in substantial agreement with those made by the Ohio State Health Department indicate the nature of the problem and the general means of correcting the existing situation. The axiom of gathering the contaminant at its source and supplying general ventilation to carry away spillage should, if properly implemented, reduce the lead level throughout to acceptable levels. The details of design and construction are not within the scope of this report, However, it is hoped that sufficient advice has been given to enable operating personnel and a competent contractor to install the equipment required. Any further assistance that can be provided by checking prints and specifications as they are developed, or by other means within the province of this Laboratory will be available on request.

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June 29, 1951