SAFETY AND HYGIENE IN THE FOUNDRY

E. Eugene Ballard
Chief Engineer
Lester B. Knight & Associates, Inc.
Chicago

THE FOUNDRY IS A GOOD PLACE TO WORK—and it can be made a better place to work by continuing efforts in furthering safety, employe welfare and hygiene.

In perhaps no other industry has there been greater improvement in working conditions in the past decade. Management has become cognizant of the major obligation of providing safe and healthful environment for employes, and the provision of such conditions has made foundries healthful and attractive.

While great improvement has been accomplished, there yet remains an opportunity and even obligation in many plants for providing safe and healthful working conditions to make the foundry a better place to work. Perhaps the most important initial step in any plant for such a program is the maintenance of good housekeeping, because a clean, neat plant usually is a safe plant. Good housekeeping may be established in any plant without undue expense, and such expense will be reflected in reduced operating costs. Having "a place for everything and everything in its place" is one of the best time savers one can have, and pays dividends in servicing the various departmental operations. Here are suggestions for a good housekeeping program:

Establish and maintain adequate trucking aisles and do not permit them to become obstructed. If floor conditions permit, painted aisle lines will provide an aid.

Establish and maintain space for idle flasks, molding and other equipment, arranged so items may be located quickly when needed for production.

Keep floors clean; sprinkle before sweeping to allay dust conditions.

Provide racks for loose tools, tongs, bails, bars, etc., and keep unused equipment in a specified place.

Require employes to keep their own "corner" or working area neat and clean with tools in proper place.

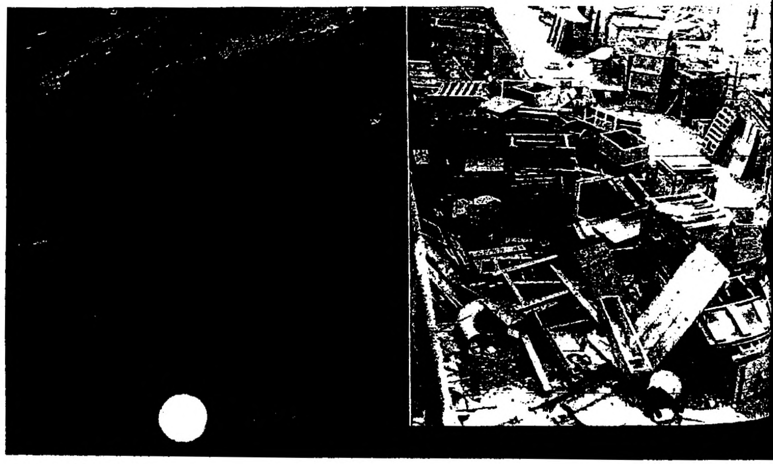
Keep ledges and window sills free of debris. Beveled sills prevent use of these areas as catch-alls.

Clean out the seldom used corners both inside and outside the plant and keep them so.

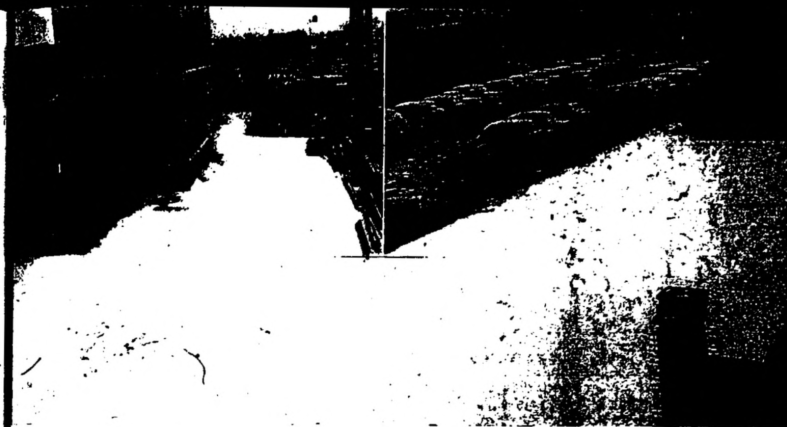
Make foremen responsible for housekeeping in their respective departments, and make regular and occasional unannounced inspection tours to further interest in and maintenance of program.

After a thorough clean-up campaign, interior painting is advised. Nothing adds more to the brightness of a plant and employe morale than a new "paint job."

Adequate lighting, both general and local, is essential both to housekeeping and efficient production.



Views of foundry flask storage yard before clean-up.



Views of foundry flask storage yard after clean-up.

Of utmost importance is cleanliness of locker and wash rooms. Adequate janitor service as well as personal rules for employes are essential in maintaining such facilities to satisfactory standards.

Good housekeeping is the first requisite for safety. There are, of course, some hazardous jobs in foundry operations, as there are in various other industries, but all such jobs can be protected and employes trained in safety measures so that hazards may be reduced to a minimum.

Here are some suggestions toward making your plant a safe one:

Proper design and arrangement of equipment to provide safe operation.

Adequate instruction and training of the employe for safety in his particular job.

Enforced use, as a condition of employment, of proper safety equipment such as safety glasses, goggles, respirators, gloves, aprons, leggings, and safety shoes.

Educational program for all employes in safety.

Maintenance of a safety committee with rotating representation from each department. Encourage their work and take action on their recommendations.

Campaign for accident prevention rather than corrective measures after some one has been injured.

Regular thorough inspections, particularly of material handling equipment, such as trucks, cranes, hoists, monorails, chains, cables, etc.

Establish program for proper maintenance of such equipment. Keep on hand replacement parts so that repairs may be made promptly. When signs of undue wear or damage to equipment is noted, fix it now rather than wait until the break occurs. Preventive maintenance is good insurance against hazardous conditions and costly shut-downs. Do not overload material handling equipment. Top-heavy loads should be prohibited and proper boxes or containers provided for transporting materials and castings.

Study accident reports, investigate causes and take preventive measures against repetition.

Recent years have focused great attention on the importance of industrial hygiene, some companies having taken the lead in this field in maintaining their own staffs of medical and industrial hygiene personnel with outstanding results. Typical programs begin with the pre-employment examination and carry through with periodic physical examinations of employes, regular surveys for unhealthful working conditions, and maintenance of first aid and emergency hospital facilities with graduate nurse in charge where the number of employes justifies. Cooperation of operating and engineering personnel with the medical department is essential to the success of the program.

Hygiene in Smaller Plants

Such programs have greatly improved plant working conditions and employe health and are well worth while in the larger plants and groups of plants. The smaller operator can initiate similar programs on a scale to suit his needs by enlisting the cooperation of the company doctor, local or state health authorities or professional industrial hygienists.

We cannot all have the "wide open spaces that we love" but we can make greater strides in making our foundries clean, healthful and inviting. One of the largest problems, other than production "headaches," in any foundry is proper ventilation, which is paramount in maintaining good working conditions. This is a broad subject on which volumes could be written, but to touch it briefly, foundry ventilation might be divided into three separate classifications.

1. General area ventilation.
2. Exhaust of fume or smoke at source.
3. Exhaust for dust suppression.

Each plant is a separate problem deserving individual study, and careful engineering consideration should be devoted to develop the ideal solutions. It generally is most desirable to trap fume or dust at the source.

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rather than by general ventilation, although there are many areas which, due to physical conditions, can be cleared only by general ventilation. Frequently a combination of general ventilation and localized exhausts is desirable; however, the latter should be favored wherever possible since such arrangements cause less load on the plant heating system.

All too often exhaust fans are installed without regard for the heating loss and resultant load on the plant heating system, and without considering that the fume and smoke-laden air removed from a room must be replaced by "make-up" air, either by infiltration or openings from adjoining buildings or areas. A powered exhaust will not do a good job working against a partial vacuum, so that it is necessary to supply clean make-up air which should be brought in near the working level, preferably through heating units, to maintain comfortable atmosphere during cold weather. In the case of localized exhausts, it is often possible to supply make-up air near the point of exhaust inlets without throwing the heating arrangements out of balance.

This foundry industry of ours is one of the oldest, and we who have it "in our veins" think it one of the best. The foundry is a good place to work, and we must hold that thought before us at all times and continue our efforts to make it a better place to work.

Acknowledgment

The author wishes to acknowledge the courtesy of E. A. Williams, vice-president, National Bearing Division, American Brake Shoe Co., St. Louis, in furnishing the plant photographs used to illustrate the paper.

Magnesium Processing and Storage Standards for Fire Prevention Listed

Causes and control of magnesium fires are given in the April 1947 quarterly report of the National Fire Protection Association. Based on test and fire data, the recommendations for preventing and extinguishing magnesium fires indicate that care and proper equipment will eliminate fire hazards almost entirely. Adequate fire protection will keep fire damage to a minimum.

The ignition temperature of magnesium is generally considered to be very close to the melting point, 1204 F, but the report points out that ribbon, chips and fine shavings can be ignited at temperatures of 950 F and below. In the case of certain alloys where the eutectic melts as low as 800 F, the metal may ignite if held sufficiently long at this lower temperature.

Silver Nitrate Test

Segregation for storage is important and a simple silver nitrate spot test may be made to identify magnesium and its alloys. The test is especially effective in distinguishing between aluminum and magnesium alloys.

The test consists of placing a drop of silver nitrate solution (5 g. $AgNO_3$ in a liter of distilled water) on the metal to be tested. A clean spot must be prepared first with sand paper or steel wool. An immediate black coloration (essentially reduced silver) indicates magnesium. No coloration appears on aluminum or most other metals. Zinc and cadmium show a coloration after approximately one hour.

Extinguishing agents for magnesium fires include G-1 powder and automatic sprinkler systems. Water streams may be used for combustible materials near magnesium fires. Extreme care must be taken to avoid accumulation of pools into which molten magnesium may run and cause severe explosions.

Causes of Fires

The most common causes of magnesium fires reported by the NFPA Committee on Magnesium are listed below:

Molten Magnesium. 1. Poor furnace design and maintenance. 2. Failure to inspect melting pots regularly.

Magnesium ingots. 1. Failure to store in small piles with adequate aisle space. 2. Storage near combustible materials.

Scrap storage. Failure to store turnings, etc. in tightly closed containers in small detached sheds. Storage in burlap bags caused a number of serious fires.

Magnesium castings. 1. Poor housekeeping, inadequate aisle clearance, proximity to combustibles and the accumulation of magnesium dust. 2. Woodworking and magnesium working operations carried on in the same room resulting in readily combustible mixtures of wood and magnesium powders.

Heat treating ovens. 1. Failure of furnace control equipment resulting in excessive temperatures—aggravated by failure of sulphur dioxide system. 2. Failure to clean chips and dust from castings prior to heat treatment.

Machining operations. Dull tools and water solution coolants.

Pictured below is Daniel Pakela and his "foundry family," they have contributed a total of 83 years service to the foundry industry. Mr. Pakela, his daughter and three sons are associated with the Erie Malleable Iron Co., Erie, Pa. Standing are Mary and Frank who have 6 and 9 year service records with Erie Malleable and seated (left to right) are Anthony, Mr. Pakela and Walter who tally 10, 40 and 18 years respectively. Mr. Pakela has been a molder for 35 years.

SELENIUM ADDITIONS TO CAST STEEL

Influence on Sulphide Inclusions and Ductility

Albert P. Gagnebin
Metallurgist
The International Nickel Co., Inc.
Bayonne, N. J.

In addition to refining the grain, selenium has the specific ability to coalesce the intergranular sulphides in low-oxide, well-killed cast steel, and thereby to improve its ductility. A demonstration of this phenomenon under a variety of conditions, as well as a theory for the mechanism of its occurrence, are discussed. A deoxidation practice for cast steel utilizing selenium is proposed and consists of the ladle addition of 0.08 per cent calcium and 0.05 per cent selenium. Extensive tests in laboratory and commercial heats show that calcium selenium promoted high ductility in steels ranging from 75,000 to 180,000 psi tensile strength and melted in acid electric, basic electric, and basic open-hearth furnaces. Calcium selenium promoted better ductility and was less likely to produce heats of low ductility than other methods of deoxidation. Moreover, it appeared to accommodate a broad latitude in melting conditions and therefore should assist in the consistent production of high quality cast steel.

The problem of obtaining globular, randomly dispersed sulphides in well-killed cast steels has been recognized for years. Low iron oxide contents which favor freedom from blowholes during solidification tend to promote thin, intergranular sulphides detrimental to ductility. High iron oxide contents, on the other hand, promote globular, randomly dispersed sulphides (a requirement for high ductility), but also increase the susceptibility to gassiness. Consequently, it is difficult to produce sound, ductile cast steel not deoxidized in any special manner, because its quality is partly dependent on the degree of oxidation at the time the steel is poured. This factor cannot readily be determined.

Sims[1] has proposed the use of large quantities of aluminum to combine freedom from porosity with high ductility, while Gagnebin[2] has suggested a combination of calcium silicide and aluminum for the same purpose. Both methods, however, require proper melting technique, including a vigorous boil to insure high quality steel. No deoxidation method yet proposed can consistently control the sulphide form in well-killed steel, regardless of the melting technique used to produce the steel.

This paper presents a new deoxidation procedure involving the use of selenium, which has been found to promote sulphide coalescence under a variety of conditions. A demonstration of this phenomenon, the mechanism of its occurrence, and tests of the proposed deoxidation procedure in both laboratory and commercial heats, are discussed.

Selenium Promotes Agglomeration

An effective demonstration of the influence of selenium on the ductility and sulphide form of a high sulphur, nickel-manganese steel, normalized and tempered is shown in Fig. 1. This heat was fractioned to show successively the influence of oxidation, aluminum deoxidation and selenium additions.

Aluminum destroyed the globular sulphides and ductility of the oxidized state, while 0.05 per cent selenium partially coalesced the sulphides, and 0.15 per cent selenium fully agglomerated them and restored the original ductility. The effect of progressive additions of selenium on the mechanical properties of aluminum-killed steel containing a normal amount of sulphur is shown in Fig. 2.

Mechanism of Sulphide Agglomeration

When selenium is added to steel, it appears to form manganese selenides which absorb the sulphides in the steel and then promote their rejection from solution before solidification is complete. The manganese or manganese-iron selenides are of medium gray color and appear to be miscible in all proportions with manganese sulphides, as no separation of the phases was noted. Figure 3 shows a typical manganese selenide-manganese sulphide inclusion in an aluminum-killed steel. The black angular constituent was absent in aluminum-free steel and therefore may be aluminum sulphide, since it varied directly with the amount of aluminum used for deoxidation.

Evidence bearing on the temperature at which sulphides were rejected from steel was developed by noting the sulphide location relative to the primary dendrite bodies and by heating steels to incipient melting to determine how much burning occurred before the sulphides disappeared. Both examinations were conducted on specimens suspended in an induction coil in a location to provide a thermal gradient, and then heated until one end melted, thus providing all degrees of overheating in a single specimen.