PELTON CASTEEL'S NEW CLEANING ROOM

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ABSTRACT

Pelton Casteel has incorporated provisions into its new cleaning and finishing facility to reduce exposure of workers to silica dust and metal fume to below allowable limits. This has been accomplished with ventilated, encapsulating booths. Special provisions in the design resolved potential problems of safety and worker acceptance. The booths were acoustically lined and partial seals were installed across openings. Although hearing protection is still needed in the booth, the noise outside the booths has been reduced to below 90dBA. Exhaust from abrasive grinding operations has been filtered and returned to the plant in winter to conserve energy. An opacity monitor signals upset conditions and automatically stops recirculation.

INTRODUCTION

With the celebration of Pelton's 50th anniversary, it was announced that a decision was made to expand the facilities to twice the capacity of the existing foundry. This decision was based on customer demand, the desire to grow and add new products, and a need to update the existing facility. Based on a feasibility study it was decided to separate cleaning and finishing, heat treating, inspection, and shipping operations into a separate facility. Castings are delivered to the new facility after removal of sprue, gates and risers.

The plant is divided into two sections, based on the size of castings processed. Castings which weigh up to 22 Kg (50 lb) are finished on the "small side" and larger castings up to 1360 Kg (3,000 lb) are finished on the "large side".

BOOTH DESIGN AND CONSTRUCTION

Safety Considerations

Ventilated and acoustically lined booths are used to encapsulate the grinders, finishers, and arc air and welding operators (Figures 1-3). It was decided to have more than one person per booth for safety reasons and also so that the worker would not feel isolated. With individual booths there is the possibility that a serious injury or illness would go unnoticed until the foreman looked in on the worker or until the end of a shift. Windows also help to relieve the feeling of isolation and facilitate monitoring the worker's well-being.

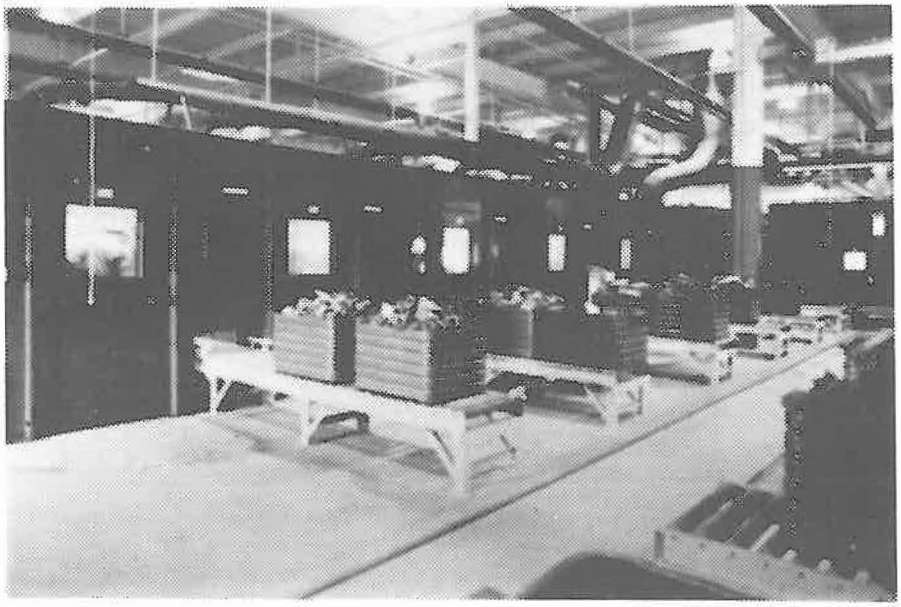

Figure 1. Row of small casting booths showing the inlet conveyors and casting bins.

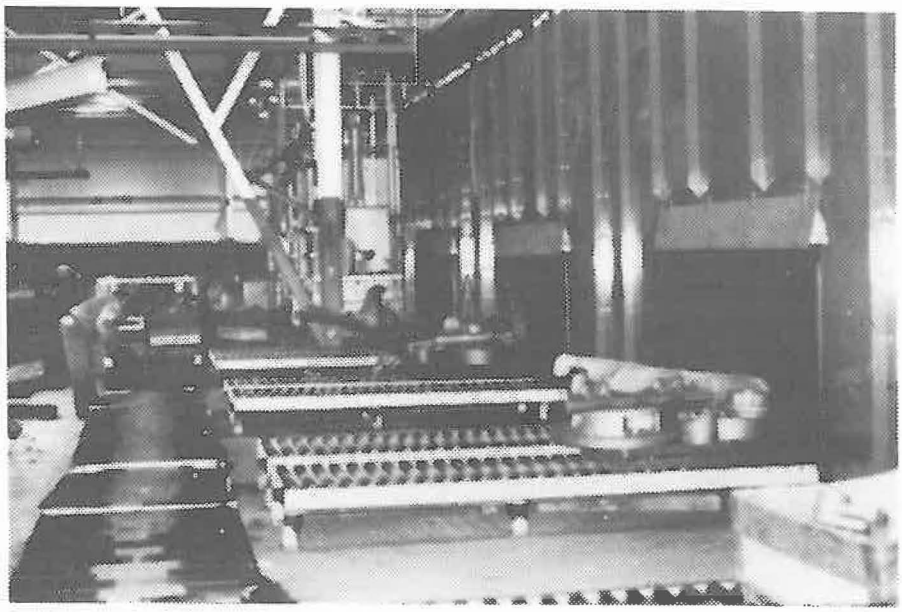

Figure 2. Large casting booths showing the inlet conveyors and castings ready to be processed.

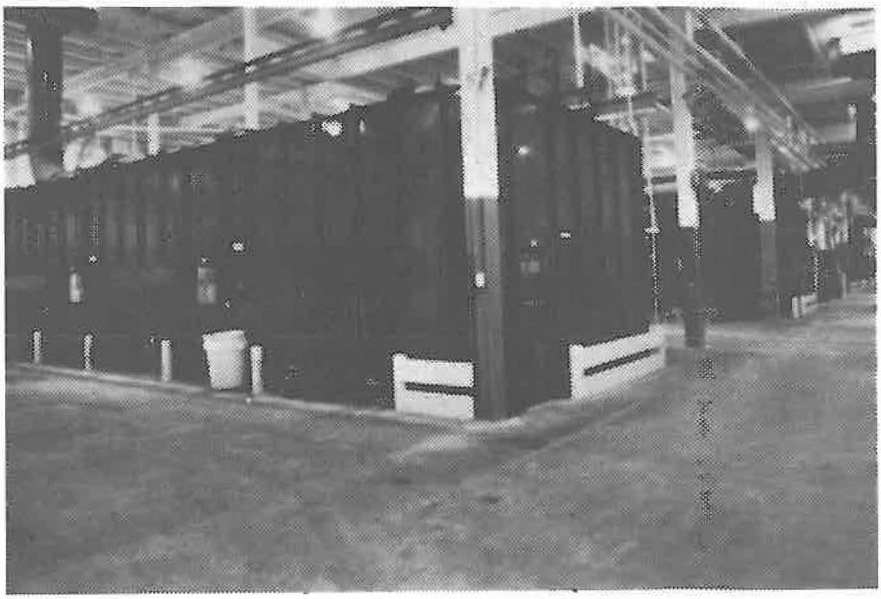

Figure 3. Dishcarge side of large casting booths.

Materials of Construction

The booths are totally enclosed and are constructed from sheet metal with sound deadening walls of 3.8cm (1.5 in.) fiberglass finished on the inside with a perforated protective liner. Rubber flaps over the casting inlet and outlet openings in the booth help to cut down noise loss through these openings.

Material Handling Provisions

There is a roller conveyor running straight through and projecting out both sides of the booths which process small castings. Bins full of castings ready to be pushed into these booths are shown in Figure 1.

The booths in which large castings are processed are also supplied using a roller conveyor (Figure 2). However, this conveyor terminates just inside the booth. Castings are loaded from the conveyor onto the workbench using an overhead hoist. After processing, the castings are loaded with the hoist onto a heat treat rack just inside the outlet opening of the booth. The heat treat racks are removed from the booths using fork lift trucks.

Ventilation Provisions

All processing stations within the booths are ventilated. Stand grinders have evacuated exhaust hoods. The remainder of the work, i.e., abrasive grinding with portable tools and casting repair using arc air and welding, is ventilated with side exhaust hoods at the back of each bench. Figures 4 and 5 show the exhaust hoods for welding and grinding of small castings, respectively. The exhaust flow rates for all of the cleaning and finishing processes within booths as well as for miscellaneous processes outside of booths in need of ventilation is presented in Table 1.

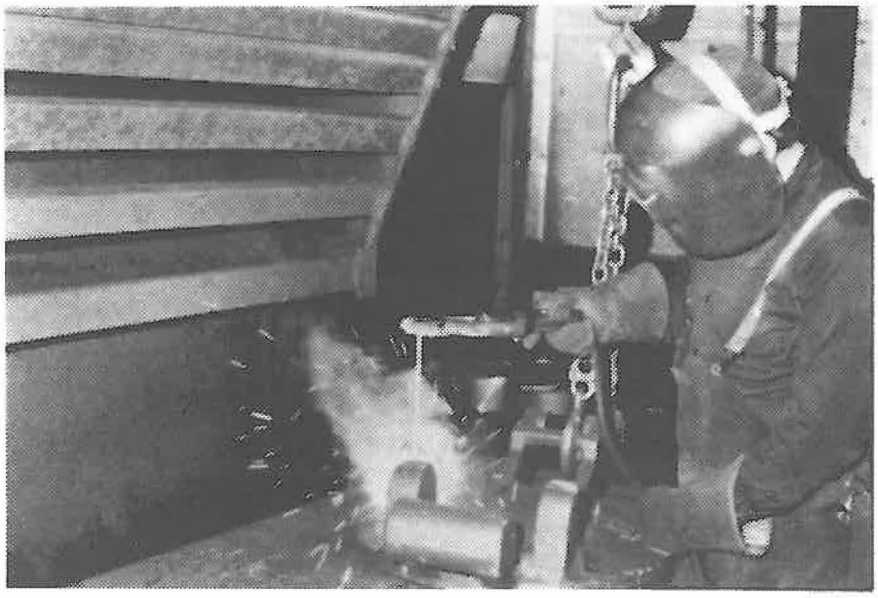

Figure 4. Fume control by side draft hood duging welding on small castings in a booth.

Figure 5. Bench grinding in samll booth with exhaust capture behind bench. Note rubber flaps sealing booth opening.

In some of the booths air is introduced above and behind the worker (indoor air in winter, outdoor air in summer) to provide additional control of the air quality in the breathing zone and comfort ventilation.

Exposure Sampling Results

The results of recent personal sampling for silica in abrasive grinding operations are presented in Table 2. All of the exposures on the "small side" were below OSHA permissible exposure limits (PEL); all but one on the large side were below the PEL.

Results of air sampling for metals are presented in Table 3. The highest values of iron oxide, at the OSHA permissible exposure limit, were found during arc air on large castings. Arc air of small castings and welding produced lower levels of iron oxide. Copper fume was controlled below allowable limits in both arc air and welding.

Table 1. Exhaust air flows from cleaning room processes.

Process	Quantity	Exhaust flow, m^3/hr	Exhaust flow, cfm	Filtering of exhaust
Work done in encapsulated booths				
Grinding wheels				
30 cm (12 inch)	5	3,060	1,800	Yes
75 cm (30 inch)	9	4,080	2,400	Yes
Bench finishing with portable chipping and grinding tools				
Small castings	8	7,500	4,400	Yes
Large castings	8	7,650	4,500	Yes
Arc air				
Small castings	2	5,950	3,500	No
Large castings	4	10,400	6,000	No
Welding				
Small castings	2	6,800	4,000	No
Large castings	7	6,800	4,000	No
Reweld station	1	10,400	6,000	No
Other exhausted processes				
Blast room	1	8,500	5,000	Yes
Magna flux	1	11,900	7,000	No
Shot blast	1	5,750	3,400	Yes
Shot blast	1	13,400	7,900	Yes
Handblast	1	3,060	1,800	Yes

Table 2. Results of personal sampling for silica in abrasive operations.

Process	Respirable or total dust	Exposure, mg/m^3	PEL, mg/m^3	% Quartz
"Small side"				
Grinding wheels				
30 cm (12 inch)	Respirable	0.24	0.67	13.0
75 cm (30 inch)	Respirable	0.63	1.54	4.5
75 cm (30 inch)	Respirable	0.42	1.01	7.9
75 cm (30 inch)	Respirable	0.29	5.0	<1
75 cm (30 inch)	Respirable	0.52	5.0	<1
75 cm (30 inch)	Total dust	2.03	15.0	<1
Bench finishing	Respirable	0.55	1.41	5.1
Bench finishing	Respirable	0.56	1.59	4.3
Bench finishing	Total dust	1.38	15.0	<1
"Large side"				
Bench finishing	Respirable	0.72	1.45	4.9
Bench finishing	Respirable	2.26	2.13	2.7
Bench finishing	Respirable	0.51	1.59	4.3
Bench finishing	Total dust	9.20	15.00	<1
Arc air	Total dust	8.8	15.0	<1
Welding	Total dust	4.72	15.0	<1

Table 3. Results of personal sampling during air and welding.

Process	Iron oxide		Copper	
	Exposure	PEL	Exposure	PEL for fume
"Small side"				
Arc air	6.35	10.0	0.030	0.100
"Large side"				
Arc air	10.92	10.0	0.064	0.100
Arc air	9.27	10.0	0.058	0.100
Welding	2.18	10.0	0.020	0.100
Welding	4.00	10.0	0.040	0.100

Recirculation of Cleaned Exhaust Air

All of the exhaust from the abrasive grinding operations in the encapsulated booths, along with selected other exhausts, are fed to a modular shaker-type baghouse. The total baghouse capacity is 204,000m^3/hr (120,000 cfm) and the air-to-cloth ratio is 3:1.

To save energy the air discharged from the baghouse is recirculated back into the plant during winter through four long plenums with distribution grilles. The plenums are mounted high in the plant along the walls (Figure 6). Upstream of each of the four plenums a monitor (Joy Mfg. Company) measures and records dust opacity (Figure 7). If readings exceed a preset trigger level, an alarm sounds and the baghouse discharge air is automatically redirected to the outdoors. Problems experienced so far which have resulted in the alarm sounding and the air bypassing are:

1. Fouling of glass on the opacity monitor.
2. Broken bags in the dust collector.

Carbon monoxide has been monitored and found not to be a problem during recirculation.

General Exhaust

Reversible fans and large plenums are used to either exhaust general plant air or supply fresh air, depending on the time of year and plant environmental conditions (Figure 8).

Noise Measurements

The use of encapsulated booths for manually processing castings has resulted in the noise level in the general area outside the booths to be reduced below 90 dBA. Inside the booths, readings when the exhaust system alone was running (no work being done) ranged from 78-82 dBA. Noise levels were measured at 87 dBA at a work station in a booth when work was not being done at that work station, but was being done in the other part of the booth. Dressing stand grinder wheels was found to lower noise levels by 5 dBA.

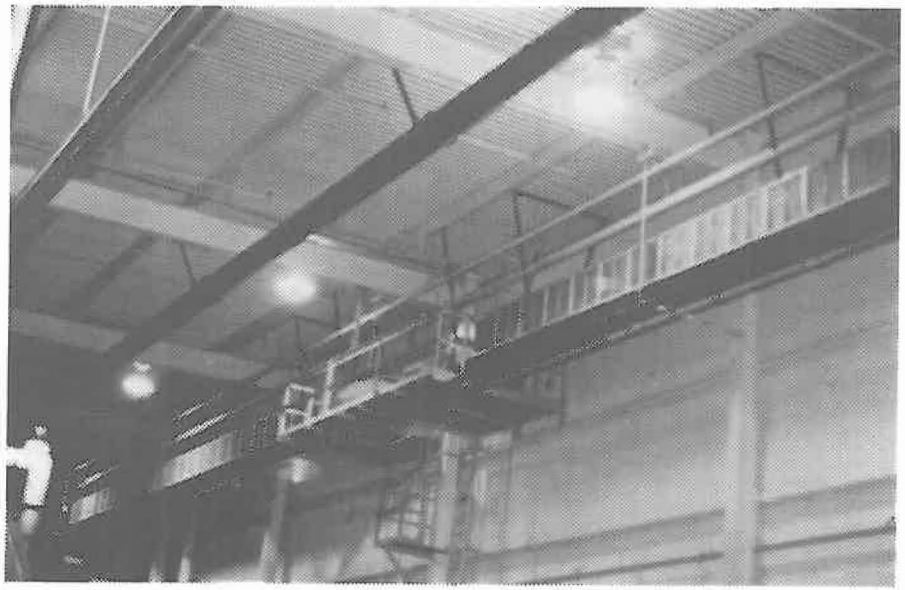

Figure 6. Two of four recirculation air plenums extending along the ceiling of the plant.

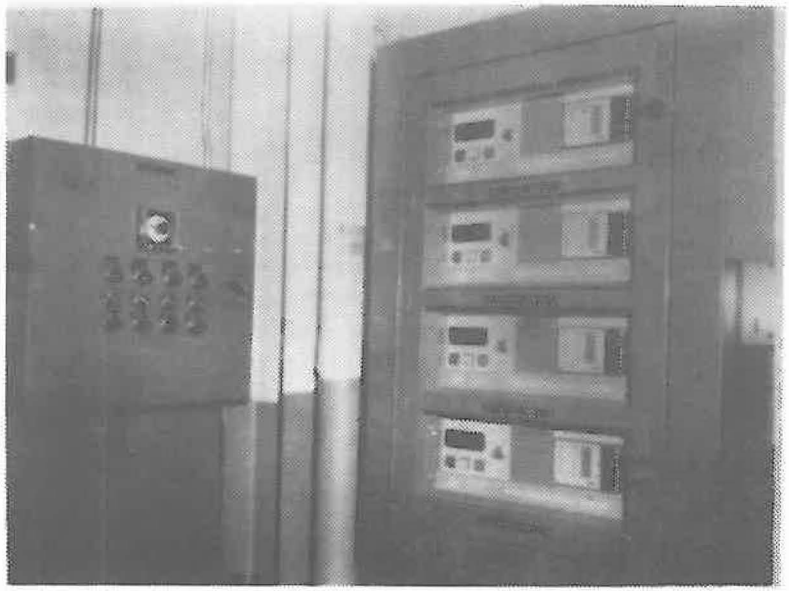

Figure 7. Recirculation system monitoring station.

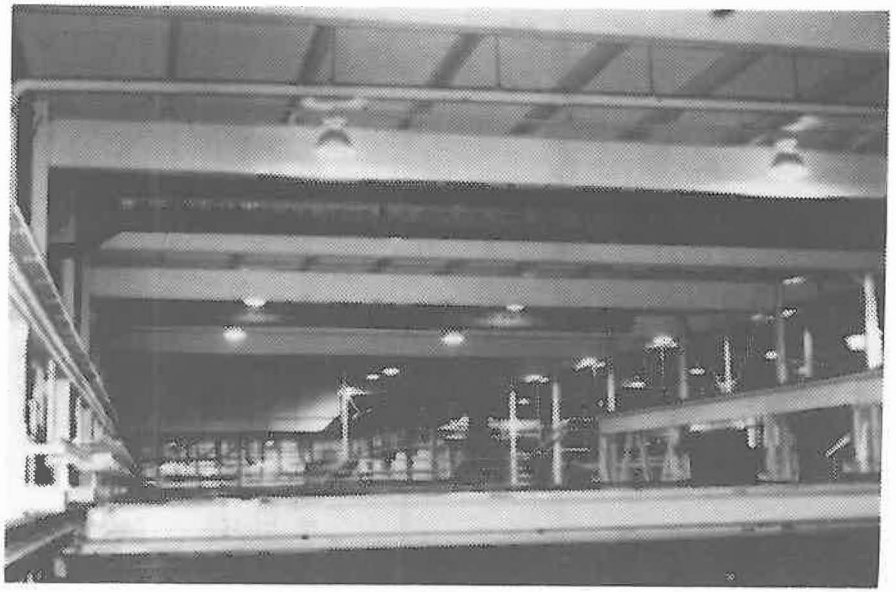

Figure 8. Typical distribution plenum for reversible general exhaust/fresh air system.

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