Report on

THE CONCENTRATION OF LEAD AND OTHER INDUSTRIAL DUSTS IN THE AIR OF WORKROOMS OF THE PLANT OF LOWE BROTHERS, INC., DAYTON, OHIO

The environmental conditions with respect to the contamination of the air of workrooms of the Dayton, Ohio, plant of Lowe Brothers, Inc., with various industrial dusts and with lead pigments, have been studied by the collection (June 5 and 7, 1946) and examination of a series of air samples. The sampling and analytical survey was designed to study the extent of the air contamination that occurred under normal operating conditions in connection with mixing and loading various dry pigments (Table 1), in unloading freight cars, and in storing bagged pigments in warehouses (Table 2). In addition a few chemical analyses were carried out on samples of materials and rafter dusts which had accumulated in various working areas. These analyses were made principally to determine the lead and free silica content of the sampled dusts or materials (Table 3). From available information, it is believed that the recorded results are representative of normal operating conditions insofar as numbers of particles and concentrations of phthalic anhydride are concerned, but that the lead findings may not be typical. This situation with reference to lead arises from the fact that leaded-zinc pigment, the principal source of the lead dust, had not been used for some time prior to June 7. As a result the dust available upon floors for dispersal into the atmosphere as the consequence of normal traffic on the mixing floor, contained less lead than usual. (Compare sample 46A-2291, Table 3, with the various rafter dusts in the same table.) The handling of leaded-zinc had been resumed

by June 7 and the results of sampling on that day are indicative of the lead contamination resulting therefrom.

The concentrations of dust and of lead in the atmosphere of various pigment-mixing areas (Table 1) are excessive only during the periods in which the mixers are being loaded with dry pigment. (Leaded zinc is the only material contributing to the lead exposure since all other lead pigments are added in paste form.) Obviously, the workmen engaged in loading the mixers or ball mills are exposed to the greatest hazards, but the severity of such exposure varies because of cross currents due to natural ventilation when the windows are open. In general, the exhaust systems on the mixers and on the hoppers of the ball mills appear to be effective in confining the greater portion of the dust to the immediate loading or filling area. The lead concentrations approach the maximum allowable concentration of 1.5 mg. per 10 cubic meters in only three instances, two of which involve only the loader engaged in handling leaded-zinc pigment. With reference to other dusts, in only four instances did the number of particles exceed 5 million per cubic foot, which is the maximum allowable concentration of asbestos or of dusts containing over 40 per cent of free (uncombined) silica. These dusts, like lead, contaminate the air in the environment of the "loaders" to a greater extent than elsewhere.

Determinations of the concentration of phthalic anhydride dust in the air were made while the anhydride was being worked into hot varnish in the pot situated under the west stack of the varnish plant. Little is known of the toxicity of this material, so that it is not possible to interpret the significance of the

findings. Nevertheless, it may be of some interest to record the experience of the observer engaged in collecting these samples. In taking sample 46A-2343, the observer followed as closely as possible the movement of the workman who was tending the pot without interfering with his freedom of action. The former wore no dust mask, but was not conscious of the presence of marked quantities of dust nor did he feel any discomfort whatsoever, although it was said that the conditions about the stack were at their worst by reason of the effects of a stiff wind which induced a back-draft in the stack. On the other hand, while collecting sample 46A-2244, he could not remain in the sampling area more than a few minutes because of intense irritation of the nose and eyes, accompanied by considerable lacrimation. This irritation was due, undoubtedly, to the presence of acrolein, which appears to be the more serious of the hazards associated with varnish-boiling. The concentrations of acrolein discharged into the area under these conditions should be determined. The quantities of phthalic anhydride recorded in the data may also be in error because the size of sample taken did not permit a reliable correction for free fatty acids which may have been retained by the absorber. It would be wise, therefore, to repeat the phthalic anhydride analyses after obtaining larger samples. This can be done concurrently with the sampling of the air for acrolein.

As could be predicted, the data of Table 2 show that the greatest dust hazards occur in car-unloading operations. This danger, however, has been recognized by the management, since each man engaged in unloading and warehousing bagged pigment is equipped with an approved dust mask. The use of skids in moving

and stacking bagged material in the basement of Building 3 tends to reduce the dissemination of dusts, as indicated by Samples 46A-2278 and 46A-2279. Manual handling in stacking individual bags, however, gives rise to appreciable dust in the air of the warehouse.

The dustiest operation was found to be the unloading of bags of Surfex MM, while the concentrations of lead in the air during the unloading of leaded zinc is of such high order as to be quite hazardous unless suitable safety measures are taken.

In Table 3 are listed chemical analyses of certain factory dusts and two bagged materials. The rafter or floor dusts contain appreciable quantities of lead, low quantities of free silica, and considerable quantities of combined silica. Although asbestine differs from asbestos in that it is a single metal silicate (magnesium silicate) instead of a mixed silicate (calcium and magnesium), it is wise to deal with it as though it were as hazardous as asbestos, for which the maximum allowable concentration is 5 million particles per cubic foot.

Conclusions

The mechanical generation of potentially harmful dusts is inevitable in association with certain of the operations of the plant. However, the use of properly designed local exhaust systems at the points of origin of such dusts serve to localize the hazards so that they involve principally the men doing the actual loading of the mixers and ball mills. The accumulation of pigment on the floor of the mixing area, on the equipment, and on other structures is a potential hazard in that heavy traffic or vibration will disperse toxic material into the atmosphere. The most hazardous work, as indicated by lead concentrations and dust counts, occurs in the unloading and warehousing of leaded-zinc

and other bagged material. These items of work are intermittent and presumably adequate safety measures (the use of dust masks) have been taken to protect the workmen.

Certain improvements in the environmental conditions would seem to be desirable and capable of achievement, and, therefore, it is recommended:

1. That the frequency of house-cleaning be increased, a vacuum system being employed to remove dusts which accumulate on the floor, rafters, and equipment;
2. That men loading mixers or ball mills with leaded zinc and pigments containing asbestine be required to wear dust masks while emptying bags of these materials;
3. That the men working on the baling machine also be equipped with dust masks;
4. That the severity of the potential exposure to lead-bearing and other dusts on the mixing floor be determined again in the winter time in order to gauge its seasonal variation.

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Concentration of Lead-bearing
in Association with O

Analysis Number	Description	Time and Date	Mg. Pb/ 10 M³
46A-2280	Near baling machine while baling on mixing floor	11:00 a.m. 6-5-46	0.37
46A-2281	In aisle between mixers 7, 8, 9, and 54, mixers 1, 2, and 3 being loaded with pigment for paint #328	11:05 a.m. 6-5-46	0.10
46A-2282	Between mixers 8 and 9 while 9 was being loaded with pigment for paint #328	11:18 a.m. 6-5-46	0.19
46A-2283	While loading ball mill 6 for paint #148. During half of loading process	11:57 a.m. 6-5-46	0.49
46A-2284	In aisle beside pony mixer 19, 20 feet from zinc stearate barrel	6-5-46	0.11
46A-2327	Near mixers 13, 14, 15. No loading underway	9:18 a.m. 6-7-46	0.05
46A-2328	In aisle near mixers 7, 8, 9. No loading underway	9:20 a.m. 6-7-46	0.08
46A-2329	In aisle 6 feet from mixer 15 which was being loaded with pigment for paint 623	9:35 a.m. 6-7-46	0.06

Table 1

and Other Industrial Dusts in the Air
peration of Certain Equipment

Millions of Particles per cu. ft.	Average Size of Particle in Microns	
4.2	4	
1.4	2	Paint 328: 7.2% ba lead (p 17.4% ba lead (p 32.2% zi 43.2% ti
2.44	1-2	Titanium magnesiu
4.7	4	Paint 148: 36.5% C 63.5 ma
0.66	4	
0.38	5	
1.32	2.5	
0.95	5	Paint 622: non-leu

Table 1

Concentration of Lead-bearing and Other Industrial Dusts in the Air in Association with Operation of Certain Equipment

escription	Time and Date	Mg. Pb/ 10 M³	Millions of Particles per cu. ft.	Average Size of Particle in Microns	
ling machine while on mixing floor	11:00 a.m. 6-5-46	0.37	4.2	4	
e between mixers , and 54, mixers nd 3 being loaded gment for paint	11:05 a.m. 6-5-46	0.10	1.4	2	Paint 328: 7.2 lea 17.4 lea 32.2 43.2
mixers 8 and 9 was being loaded gment for paint	11:18 a.m. 6-5-46	0.19	2.44	1-2	Titanium magne
oading ball mill 6 at #148. During loading process	11:57 a.m. 6-5-46	0.49	4.7	4	Paint 148: 36. 53.
e beside pony 9, 20 feet from carate barrel	6-5-46	0.11	0.66	4	
xers 13, 14, 15. ing underway	9:18 a.m. 6-7-46	0.05	0.38	5	
e near mixers . No loading y	9:20 a.m. 6-7-46	0.03	1.32	2.5	
e 6 feet from 5 which was being with pigment for	9:35 a.m. 6-7-46	0.06	0.95	5	Paint 522: non

Table 1 continued

Analysis Number	Description	Time and Date	Mg. Pb/ 10 M3	Millions of Particles per cu. ft.	Average Size of Particle i Microns
46A-2330	Two feet above mixer 10, at breathing level of operator loading for paint #9625	9:55 a.m. 6-7-46	<0.05	2.05	4
46A-2331	Three feet from mixer 4, pointed toward 1 and 6 which was being loaded with pigment for paint #328	9:55 a.m. 6-7-46	0.47	0.83	6
46A-2332	While loading mixer 6 above at breathing level of operator (paint 328)	9:55 a.m. 6-7-46	19.2	27	2
46A-2333	In aisle S.E. end of room, sampler moving before mixers 1-15, while baling machine was operating and mixer 7 was being loaded for paint #328	10:10 a.m. 6-7-46	0.85	1.15	3
46A-2334	In aisle N.E. end of room. Same time as above. Sampler moving in aisle.	10:10 a.m. 6-7-46	0.36	1.03	5
46A-2335	Sampler moving in area before elevator	10:25 a.m. 6-7-46	0.37	0.89	2.5
46A-2336	Circulating about mixer 9 while loading it with pigment for paint #328	10:35 a.m. 6-7-46	1.18	7.3	8
46A-2337	In lacquer plant while mixing for paint C7149	11:30 a.m. 6-7-46	0.75	23	9

Description	Time and Date	Mg. Pb/ 10 M³	Millions of Particles per cu. ft.
above mixer 10, hing level of loading for 625	9:55 a.m. 6-7-46	<0.05	2.05
et from mixer 4, toward 1 and 6 s being loaded ment for paint	9:55 a.m. 6-7-46	0.47	0.83
ading mixer 6 breathing level tor (paint 328)	9:55 a.m. 6-7-46	19.2	27
S.E. end of room, moving before -15, while baling was operating and was being loaded t #328	10:10 a.m. 6-7-46	0.85	1.15
N.E. end of room. e as above. moving in aisle.	10:10 a.m. 6-7-46	0.36	1.03
moving in area levator	10:25 a.m. 6-7-46	0.37	0.89
ing about mixer 9 ading it with for paint #328	10:35 a.m. 6-7-46	1.18	7.3
er plant while or paint C7449	11:30 a.m. 6-7-46	0.75	23

Average Size of Particle in Microns	Remarks
4	Paint 9625: non-leaded zinc pigment Window open, air currents toward mixer 12 away from precipitator and loader
6	Paint 328 on this day contained leaded zinc. Normal traffic; moving and unloading skids in area
2	Pigment contained leaded zinc.
3	Pigment contained leaded zinc. Normal truck and employee traffic.
5	Pigment contained leaded zinc. Normal truck and employee traffic
2.5	
8	Pigment contained leaded zinc. Impinger sample
9	Non-leaded zinc pigment. Impinger sample

Table 1 continued

Analysis Number	Description	Time and Date
46A-2338	In lacquer plant while loading ball mill 3 with pigment for paint #13688 during soapstone loading	12:05 p.m. 6-7-46
46A-2339	Same as above, while loading titanox and iron oxide	12:20 p.m. 6-7-46
46A-2343	Varnish boiling in west stacks, during maximum exposure at operator's stand. Back drafts in stack caused by stiff breeze	11:50 a.m. 6-7-46
46A-2344	In S.W. corner of room. Said to represent normal exposure where back drafts noted above occur.	12:05 p.m. 6-7-46

Mg. Pb/ 10 M3	Millions of Particles per cu. ft.	Average Size of Particle in Microns	Re
0.65	16.6	5	Non-leaded zinc Impinger sample
2.04	2.5	5	Non-leaded zinc Impinger sample

95 mg. phthalic anhydride dust per 10 cubic meters

47 mg. phthalic anhydride dust per 10 cubic meters

Sharp irritation plus lacrimation oil (acrolein)

...tion	Time and Date	Mg. Pb/ 10 M³	Millions of Particles per cu. ft.	Average Size of Particle in Microns	
...t while ...ill 3 with ...int #13688 ...me loading	12:05 p.m. 6-7-46	0.65	16.6	5	Non-leaded zin Impinger sampl
...g while ...ex and	12:20 p.m. 6-7-46	2.84	2.5	5	Non-leaded zin Impinger sampl
...in west ...maximum ...erator's ...drafts in ...by stiff	11:50 a.m. 6-7-46	95 mg. phthalic anhydride dust per 10 cubic meters			
...er of room. ...ant normal ...back ...above occur.	12:05 p.m. 6-7-46	47 mg. phthalic anhydride dust per 10 cubic meters			Sharp irritati plus lacrimati oil (acrolein)

Concentration
in Freight Cars and

Analysis Number	Description	Time and Date
46A-2275	On loading platform near door 1 while loading leaded zinc onto skids	9:10 a.m. 6-5-46
46A-2276	Inside car (above) when half unloaded	9:35 a.m. 6-5-46
46A-2278	In storage basement of building 3, east end while moving skids into place	10:25 a.m. 6-5-46
46A-2279	In storage basement of building 3, west end near janitor's station, stacking of skids continued	10:40 a.m. 6-5-46
46A-2285	Inside box car while unloading Asbestine	2:00 p.m. 6-5-46
46A-2286	Inside box car while unloading Titanox RC	2:20 p.m. 6-5-46
46A-2326	Inside box car while unloading Surfex MM	8:30 a.m. 6-7-46
46A-2340	In warehouse before stacking materials	1:40 p.m. 6-7-46
46A-2341	In warehouse while stacking bagged Rocko Whiting	2:00 p.m. 6-7-46

Table 2

of Lead-bearing and Other Dusts
arehouses During Handling of Materials

Mg. Pb/ 10 M³	Millions of Particles per cu. ft.	Average Size of Particle in Microns		Le
			Leaded zinc:	35 65
19.7	12.7	2.5		
66.0	40.6	3.0		
0.38	1.7	3.0		
0.16	0.86	1.5		
1.36	19.6	5	Asbestine:	mag
0.51	24	2.5	Titanox RC:	30 70
0.63	130	< 2.0		
0.06	0.35	6		
0.41	19.7	2.5	Rocko Whiting:	

Table 2

Concentration of Lead-bearing and Other Dusts
in Freight Cars and Warehouses During Handling of Laterials

Description	Time and Date	Mg. Pb/ 10 M³	Millions of Particles per cu. ft.	Average Size of Particle in Microns	
ing platform near while loading loaded to skids	9:10 a.m. 6-5-46	19.7	12.7	2.5	Leade zinc:
car (above) when loaded	9:35 a.m. 6-5-46	66.0	40.6	3.0	
a e basement of g 3, east end while skids into place	10:25 a.m. 6-5-46	0.38	1.7	3.0	
age basement of g 3, west end near 's station, stacking s continued	10:40 a.m. 6-5-46	0.16	0.86	1.5	
box car while unload- estine	2:00 p.m. 6-5-46	1.36	19.6	5	Asbestine:
box car while unload- anox RC	2:20 p.m. 6-5-46	0.51	24	2.5	Titanox RC:
box car while unload- fex MM	8:30 a.m. 6-7-46	0.63	130	< 2.0	
house before stack- erials	1:40 p.m. 6-7-46	0.06	0.35	6	
house while stacking Rocko Whiting	2:00 p.m. 6-7-46	0.41	19.7	2.5	Rocko Whiting

Table 3

Chemical Composition of Certain Dusts and Bag

Analysis Number	Description	Date Collected	% Pb	% Loss on Ignition
46A-2287	Rafter dust, east end of basement of building 3	6-5-46	2.85	30.94
46A-2288	Rafter dust, west end of basement of building 3	6-5-46	2.08	
46A-2289	Rafter dust, east end of mixing room	6-5-46	0.59	27.1
46A-2290	Rafter dust, west end of mixing room	6-5-46	2.58	12.7
46A-2291	Dust from floor of baling booth	6-5-46	0.42	
46A-2292	Asbestine (magnesium silicate)	6-5-46	0.00001	2.54
46A-2293	Titanox RC	6-5-46	0.00002	
46A-2342	Rafter dust, warehouse	6-7-46	1.0	

*Corrected for solubility loss due to treatment with hydrofluosilicic acid.

Table 3

Chemical Composition of Certain Dusts and Bagged Pigments

...tion	Date Collected	% Pb	% Loss on Ignition	% Loss After HCl Treatment	% Combined Silicat
... end of basement	6-5-46	2.85	30.94	37.32	29.22
... end of basement	6-5-46	2.08			
... end of mixing	6-5-46	0.59	27.1	12.2	53.95
... end of mixing room	6-5-46	2.58	12.7	31.1	47.08
... of baling booth	6-5-46	0.42			
...ium silicate)	6-5-46	0.00001	2.54	8.00	87.46
	6-5-46	0.00002			
...rehouse	6-7-46	1.0			

...ss due to treatment with hydrofluosilicic acid.