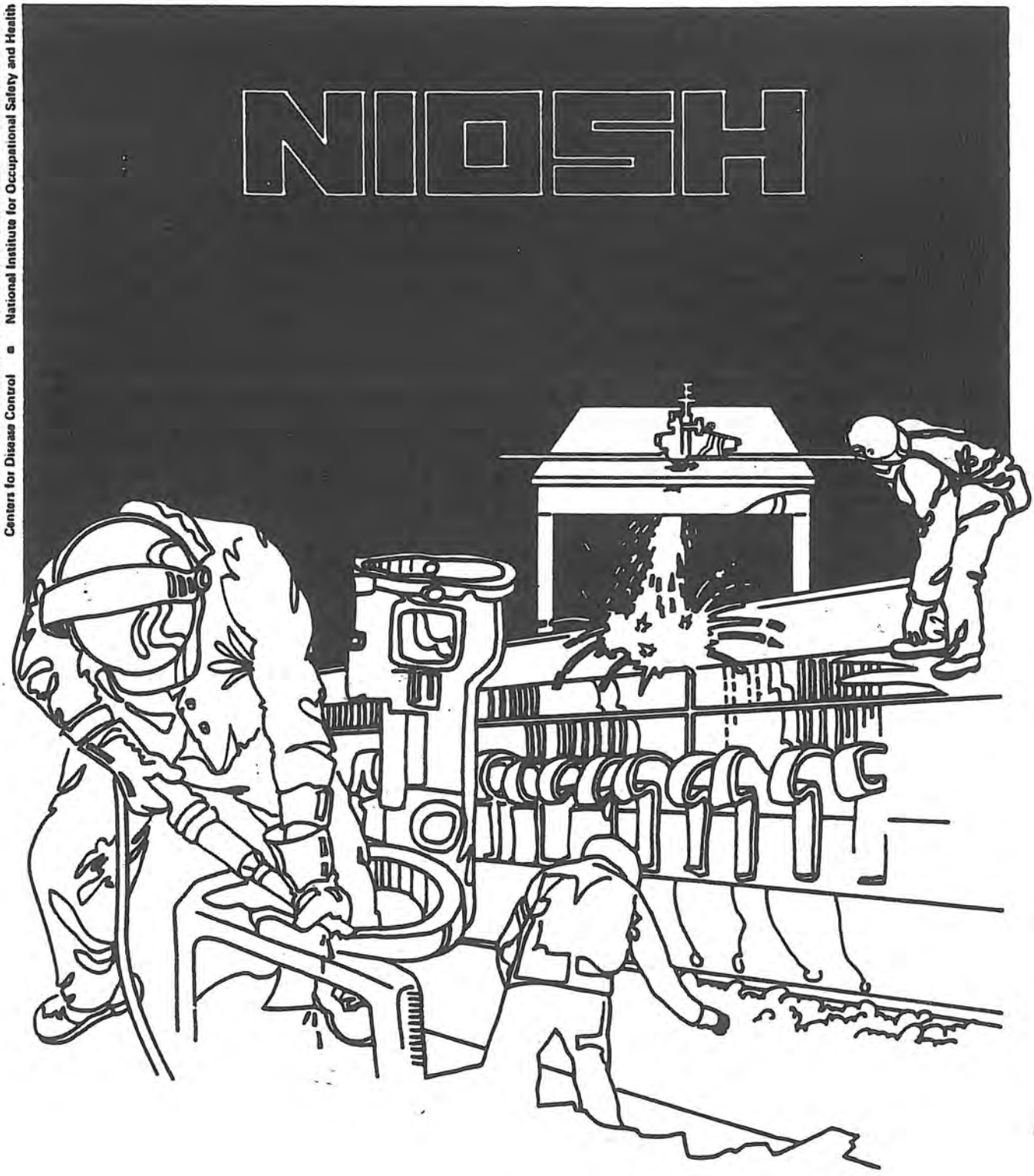
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health

NIOSH



Health Hazard Evaluation Report

HETA 85-518-1737
LCI EXCELON PRODUCTS, INC.
WOODLAND, WASHINGTON

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

HETA 85-518-1737
October 1986
LCI EXCELON PRODUCTS, INC.
WOODLAND, WASHINGTON

NIOSH Investigator:
Arvin G. Apol

I SUMMARY

In August 1985, the National Institute for Occupational Safety and Health (NIOSH) received a request from LCI Excelon, Woodland, Washington, to evaluate occupational exposure to solvent vapors during the manufacture of graphite fishing rods.

An initial survey was conducted on August 28, 1985, and environmental surveys were conducted on December 12, 1985, and March 4, 1986. An interim report was submitted to LCI on September 11, 1986.

Seven personal breathing zone samples were collected to determine the workers' exposure to the vapors of various solvents used in their respective jobs. The employees' exposure to the acetone and xylene solvent vapors ranged from 1 to 50% of the evaluation criteria. Several employees reported experiencing occasional headaches and dizziness from exposures to solvent vapors, but not on the day of the sampling. The coaters' exposure to 2-ethoxyethyl acetate and 2-ethoxyethanol was 92% of the ACGIH criteria; however, since there is evidence that 2-ethoxyethanol causes adverse reproductive effects, NIOSH recommends that exposure should be kept to the lowest feasible limit. The employees reported occasional health effects associated with the fume generated during the tacking operation and during the use of the epoxy glues and solvents in the rod building and finishing operation.

Local exhaust ventilation at the tacking tables and the processes where the solvents are used could reduce exposures to these materials. Substitution of lesser toxic solvents for the 2-ethoxyethanol and 2-ethoxyethyl acetone present in the coating material should be accomplished. Dermatitis resulting from skin contact with the high temperature cure resins and the epoxy glue used in rod building has occurred in the past and the potential for reoccurrence is still present. Good personal hygiene and protective clothing can reduce this potential.

On the basis of the data obtained from this investigation, it has been determined that the workers may occasionally be exposed to solvent vapors in sufficient concentrations to produce headaches, dizziness and lightheadedness. Workers are exposed also to epoxy resins that, upon direct contact with the skin, can produce dermatitis. The worker performing the coating operation is exposed to 2-ethoxyethanol, a solvent that has shown to produce adverse reproductive effects. Recommendations to 1) reduce exposure to other solvents through the use of engineering controls, and 2) reduce epoxy resin contact through the use of good personal hygiene and protective clothing are listed in Section VIII of this report.

KEYWORDS: Sic 3949 (Sporting and athletic goods - fishing tackle) acetone, N-butyl alcohol, 2-ethoxy ethanol, 2-ethoyethyl acetate, epoxy resins, fiberglass, graphite, methyl ketone, xylene.

II INTRODUCTION

In August 1985, the National Institute for Occupational Safety and Health (NIOSH) received a request from the management of LCI Excelon, Woodland, Washington, to determine the employees' health risks and solvent vapor exposures during the manufacture of graphite fishing rods.

An initial survey was conducted on August 28, 1985; environmental surveys were conducted on December 12, 1985, and March 4, 1986. An interim report was submitted to LCI on September 11, 1986.

III BACKGROUND

LCI Excelon, Woodland, Washington, manufactures fiberglass and graphite fishing poles.

Blank production--Various size pieces of material are cut from either fiberglass sheets or graphite fiber sheets that have been impregnated with a high temperature cure epoxy resin. The material is attached to a mandrel by heating an edge with a handheld heating iron while it is touching the mandrel. The mandrel with the attached material is placed on a rolling table and the material is tightly rolled on the mandrel to form a blank. It is then wrapped with a heat shrink plastic. A number of these blanks are loaded vertically in a rack and placed in an oven and heated to 360°F. to cure the resin. After curing, the blanks are removed from the mandrel, the heat shrink plastic is removed and the blank is wet sanded. The blanks are then coated with either a clear or colored coating, dried in an oven and trimmed to the appropriate length. The completed blanks proceed to the rod shop where cork handles are fitted and glued on using an epoxy glue. The guides are attached to the rods by wrapping thread over the guide ends. This is followed by the application of an epoxy coating over the threads which is then allowed to cure. The completed rod is then packaged and shipped.

The company moved to another facility in mid-1986. The curing oven is now in a separate room that contains exhaust ventilation. Later in 1986 they plan to install local exhaust ventilation on the tacking table, coating operation and in the rod build up area.

IV EVALUATION DESIGN

A. Environmental

Six samples were collected on December 12, 1985 to determine which aromatic and aliphatic amines were being released during the tacking

and curing operations. No amine compounds were detected in any of the samples; hence, no samples for amines were collected during the follow-up survey.

Environmental breathing zone air samples were collected over a two day period (March 4, 1986) to determine the employees' exposures to one or more of the substances listed below:

Substance	Collection Method	Flow Rate	NIOSH Analytical Method
Acetone	Charcoal tube	50 cc/min	1300
N-butyl alcohol	Charcoal tube	50 cc/min	1401
2-ethoxyethyl acetate	Charcoal tube	50 cc/min	1401
2-ethoxyethanol	Charcoal tube	50 cc/min	1401
Methyl ethyl ketone	Charcoal tube	50 cc/min	1401
Xylene	Charcoal tube	50 cc/min	1501

B. Medical

The medical evaluation consisted of a short questionnaire administered by the NIOSH investigator regarding employees' past and present health effects consisting of headache, dizziness, nausea, lightheadedness, skin rash, dermatitis and others.

V EVALUATION CRITERIA

A. Environmental Criteria

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the workers to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent becomes available.

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and recommendations; 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's); 3) the U. S. Department of Labor (OSHA) occupational health standards; and 4) the Washington Industrial Safety and Health Agency (WISHA) Standards. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding WISHA or OSHA standards. Both NIOSH recommendations and ACGIH TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended exposure limits, by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendation for reducing these levels found in this report, it should be noted that industry is legally required to meet those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures. The relevant criteria are as follows:

Substance	NIOSH or (ACGIH) Recommended Criteria 10 Hr TWA	WISHA and/or OSHA Standards 8 Hr TWA	Health Effects
Acetone	250 ppm	1000 ppm	Irritation of eyes, nose, throat; headache; dizziness; dermatitis
N-Butyl Alcohol	50 ppm skin (ACGIH)	100 ppm	Irritation of eyes, nose, throat; dizziness; headache; drowzy; dry cracked skin
2-Ethoxyethyl acetate	5 ppm skin (ACGIH)	100 ppm	Irritation of eyes, nose, kidney damage
2-Ethoxyethanol	Lowest feasible limit (NIOSH) 5 ppm (ACGIH)	200 ppm	Hematologic effects, liver, kidney, lung damage, irritation of eyes. Evidence of adverse reproductive effects.
Methyl ethyl ketone	200 ppm (ACGIH) (NIOSH)	200 ppm	Irritation of eyes, headache, dizziness, dry skin.
Xylene	100 ppm 200 ppm 10 min ceiling	100 ppm	Irritation & dryness of eyes, nose, throat & skin; dizziness; headache, nausea; vertigo; impaired memory

VI RESULTS AND DISCUSSION

A. Environmental

The workers' exposures to the chemicals used in various jobs follows. The sample results are shown in Tables 1 and 2.

Blank Shop - The pattern cutters, tackers, rollers and wrappers have contact with the high temperature curing epoxy resins impregnated in the fiberglass and graphite sheets. Skin contact with this material has apparently produced contact dermatitis among several of the

current workers. Rubber gloves used along with cotton liners (undertaker's gloves) by these workers will aid in the prevention of dermatitis. A fume is produced when the tackers attach the material to the mandrel with a hot iron. This fume passes through the tackers' breathing zone. Samples of this fume collected on December 12 were analyzed for aliphatic and aromatic amines. Sample results were all below detectable levels. The manufacturer of this material was contacted, but he stated that they have not been able to identify the components of the fume produced during the tacking and also during the curing process. The tacking tables should be equipped with slot ventilation along the back of the table to remove the fume as it is produced. Lowering the temperature of the iron with a rheostat will reduce the amount of fume generated. The tacker-roller is exposed to acetone vapors. On the day of sampling, the acetone concentration was 19 ppm which is 8% of the evaluation criteria.

The blanks are placed in the curing oven to cure the epoxy resins at a high temperature. Fume is emitted from the oven during the cure. Some of the fume is exhausted outdoors, and some enters the work area. Several employees, as noted in the medical section of this report, occasionally experience eye and throat irritation from the fumes. The new cure oven room has exhaust ventilation. The isolation of the ovens plus the exhaust ventilation should prevent the occurrence of the symptoms.

The coater is exposed to the solvents present in the coating materials. They include n-butyl alcohol, 2-ethoxyethyl acetate, 2-ethoxyethanol, and methyl ethyl ketone.

NIOSH, in its Current Intelligence Bulletin #39 (DHHS-NIOSH Publication No. 83-112) for 2-ethoxyethanol, considers 2-ethoxyethanol as having the potential to cause adverse reproductive effects in male and female workers and as such recommends controls to minimize worker exposure to this compound. The American Conference of Governmental Industrial Hygienists recommends that exposures to 2-ethoxyethanol and 2-ethoxyethyl acetate be kept below a time weighted average concentration of 5 ppm. The exposure during the sample period was 92% of this criteria. Since the time spent coating each day is approximately 2 hours, the 8 hour time weighted average concentration would be approximately 25% of the criteria. Coating materials should be purchased that do not contain these solvents. There are other solvents that can be substituted for 2-ethoxyethanol and 2-ethoxyethyl acetate. Also there are other coating materials available on the market that do not contain them.

The new facility utilizes local exhaust ventilation directly behind the coater. This should reduce the coater's exposure to these solvents; however, total elimination of these solvents is highly recommended.

The set up workers are exposed to epoxy resins and xylene which is used as a cleaning solvent for the resins. The airborne xylene vapor exposures ranged from 6 to 49 ppm which would be less than the evaluation criteria of 100 ppm. These workers have experienced headache, dizziness, and lightheadedness which are consistent with xylene exposure. Although these concentrations are less than the criteria, the use of local exhaust ventilation, e.g., slot ventilation along the center of the table, would prevent the vapors from the xylene and the epoxy resins from passing through the breathing zone of these workers.

Skin contact with the epoxy resins used to glue the cork handles onto the rods can cause dermatitis. Protective gloves with cotton liners and plastic gauntlets can prevent skin contact. Conveniently located wash basins to immediately remove any resins can prevent the dermatitis.

The finishers use small amounts of epoxy resin and solvent. The solvent exposures consisted of a combination of acetone and xylene, and was less than 10% of the evaluation criteria.

B. Medical

Six workers in the blank area and shipping department were administered the questionnaire. Their time with LCI ranged from 1 week to 4 years. Two had worked for other firms in this industry. Three reported skin rashes when tacking; two of the three experienced eye, nose and throat irritation and one has frequent headaches. They are exposed to fumes generated when the graphite sheets, impregnated with resins, are heated with the tacking iron and they have skin contact with the uncured resins in the sheets.

Six workers in the rod shop were administered the questionnaire. Their employment time with LCI ranged from 5 weeks to 5 years. Four have experienced skin rashes as a result of mixing and using epoxy glue. The 30 minute cure epoxy glue that is occasionally used was stated to be worse than the longer cure epoxy glue. Three workers have experienced headaches with one having a headache almost daily. It appears to be caused by the xylene used in this area.

Six workers in the finishing area were administered the questionnaire. Their employment with LCI ranged from 6 months to 5-1/2 years. Four had occasional headaches and one of the four also experienced dizziness and lightheadedness. Small quantities of epoxy glue and xylene are used in this area.

VII SUMMARY AND CONCLUSIONS

The employees' exposure to the acetone and xylene solvent vapors ranged from 1 to 50% of the evaluation criteria. Several employees reported experiencing occasional headaches and dizziness from exposures to solvent vapors, but not on the day of the sampling. The coaters' exposure to 2-ethoxyethyl acetate and 2-ethoxyethanol was 92% of the ACGIH criteria; however, since there is evidence that 2-ethoxyethanol causes adverse reproductive effects, NIOSH recommends that exposure should be kept to the lowest feasible limit. One employee reported occasional health effects associated with the fume generated during the tacking operation and the use of the epoxy glues and solvents in the rod building and finishing.

Local exhaust ventilation at the tacking tables and during the processes where the solvents are used could reduce exposures to these materials. Dermatitis resulting from skin contact with the high temperature cure epoxy resin and the epoxy glue used in rod building has apparently occurred in the past. Good personal hygiene and protective clothing can reduce the incidence of this occurring. Substitution of lesser toxic solvents for the 2-ethoxyethanol and 2-ethoxyethyl acetone present in the coated material should be accomplished.

VIII RECOMMENDATIONS

1. Eliminate the use of coating materials that contain 2-ethoxyethanol and 2-ethoxyethyl acetate.

2. Provide local exhaust ventilation on the following processes:

   a. tacking tables;

   b. coating operation;

   c. rod building set up.

3. Lower the temperature of the hand held iron used for tacking.

4. Label all solvent containers and use only safety cans and plunger cans for transferring and dispensing the solvents.

5. Persons who handle and work with epoxy resins should wear protective gloves with liners. Cotton gloves work well as glove liners.

6. Any epoxy resin that contacts the skin should be washed off immediately. Conveniently located wash basins will be more readily used by the workers. Clothing that becomes contaminated with epoxy resin should be changed.

7. Place all flammable solvent soaked rags and cotton swatches in self-closing containers or fire surpressing containers.

8. Do not use xylene to wash epoxy resins from the skin as xylene removes the skin oils, dries the skin and increases the possibility of developing dermatitis.

IX AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared by:

Arvin G. Apol, C.I.H., M.S.
Industrial Hygienist
NIOSH, Region X
Seattle, Washington

Originating Office:

Hazard Evaluation & Technical Assistance Branch
Division of Surveillance, Hazard Evaluation & Field Studies
Cincinnati, Ohio

X DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. Information regarding its availability through NITS can be obtained from NIOSH, Publications Office, at the Cincinnati address.

Copies of this report have been sent to:

1. LCI Excelon, Woodland, Washington
2. Washington State Department of Labor and Industries, Olympia, WA
3. U. S. Department of Labor/OSHA - Region X

For the purpose of informing affected employees, a copy of this report shall be posted in a prominent place accessible to ther employees for a period of 30 calendar days.

Table 1

Acetone, N-Butyl Alcohol, 2-Ethoxyethyl acetate, 2-Ethoxyethanol, Methyl Ethyl Ketone, and Xylene Air Concentrations

LCI Excelon, Inc.
Woodland, Washington
HETA 85-518

Job	Date	Sample Number	Sample Time Minutes	Sample Volume Liters	Acetone ppm	Xylene pm	N-Butyl Alcohol ppm	2-Ethoxy-ethyl acetate ppm	2-Ethoxy-ethanol ppm	Methyl ethyl ketone ppm
Glue Handles	12-12-85	C-5	131	27.4	3.5	49	-	-	-	-
Finishing	12-12-85	C-6	127	25.7	23.0	1	-	-	-	-
Tack & Rolling	3-4-86	1	437	25.9	19.0	-	-	-	-	-
Finishing	3-4-86	2	436	19.8	17.0	1	-	-	-	-
Rod Shop - Glue Handles	3-4-86	3	430	24.4	1.0	6	-	-	-	-
Rod Shop - Glue Handles	3-4-86	4	430	25.0	0.2	11	-	-	-	-
Coater	3-4-86	5	140	9.0	-	-	ND (0.7)	0.6	4	3