Table 15. Workers' Home Contamination--Industrial Hygiene Aspects

Author [year] Location	Contaminant Basis for Study	Process	Industrial Hygiene Methodology	Industrial Hygiene Observation	Comments or Recommendations
Bohne and Cohen [1985] Ohio	Beryllium	Beryllium production	Fabrics exposed at worksite.	Electrostatic charges increased fabric contamination of cotton, but not Nomex® fabric loading up to 2,800 $\mu g/m^2$.	
Chamberlin et al. [1957] Pennsylvania	Beryllium	Beryllium plant		5 patients were family members of beryllium workers and cleaned their dusty clothes.	The authors state: "The introduction of proper industrial hygiene measures has evidently reduced the number of new cases of chronic granulomatous pneumonitis due to secondary transfer, since none has been seen by us for the past three years."
Chesner [1950] Ohio	Beryllium	Beryllium plant	Case histories of chronic pulmonary granulomatosis	Woman used empty beryllium ore bags for dish clothes. She got the bags from a neighbor who worked at the plant.	
Cohen and Positano [1986] Ohio	Beryllium	Beryllium refinery	New and used shirts worn at work were analyzed for beryllium in the fabric. Fabrics were agitated in a glove box to measure re-suspended beryllium.	Beryllium concentrations ranged from 12 to 37 mg/m^2 in unwashed shirt fabric. Air concentration of beryllium measured in refinery was only a fraction of the PEL of 0.002 mg/m^3. The old shirts also showed significantly higher concentrations of beryllium and resuspended significantly higher quantities of beryllium to the air than newer shirts.	Concentrations of resuspended dust from old, unwashed shirts up to 0.64 $\mu g/m^3$ were found.
Eisenbud et al. [1949] Ohio	Beryllium	Beryllium production.	Study of dust generated by laundry procedures using 100 uniforms worn for one day by plant employees.	Air concentrations of beryllium: shaking soiled clothes 0.1-1.2 mg/m^3; scrubbing 3-7 $\mu g/m^3$; shaking and folding washed clothes 4-6 $\mu g/m^3$. Estimated inhalation dose during single home-cleaning of work clothes was 17 μg of beryllium.	
Anderson et al. [1979b] New Jersey	Asbestos	Amosite asbestos product manufacturing	Evaluate health status of 679 household contacts of asbestos workers. Interviews, X-rays, physical exams.	Family contacts had no other known asbestos exposure. 35% of household contacts had radiographic abnormalities vs. 5% of controls.	Plant did not have change rooms or change of clothing available; clothes were washed at home.

Table 15. (Continued) Workers' Home Contamination-Industrial Hygiene Aspects

Author [year] Location	Contaminant Basis for Study	Process	Industrial Hygiene Methodology	Industrial Hygiene Observation	Comments or Recommendations
Belanger et al. [1979] Illinois	Asbestos	Vinyl asbestos & asphalt asbestos floor covering manufacturing	Personal & area sampling	Separate lockers for clean and dirty clothes. Coveralls provided. Showers provided.	Recommendations were made to change clothes and leave all work clothes at work. Specifically, work clothes must not be taken home to be washed as this could expose others at home.
Bianchi et al. [1987] Italy	Asbestos	Asbestos related industries	Interviews to determine occupational histories and practices of washing clothes at home.	For women, cleaning work clothing was the main source of exposure. Many women were exposed in this way for more than 20 years.	
Driscoll and Elliott [1990] Michigan	Asbestos	Manufacturing of asbestos brake linings; production of adhesives, sealers and paints.	Vacuumed samples of work clothes and car seat via phase contrast microscopy (PCM) and transmission electron microscopy (TEM).	Vacuum Samples: all clothing (n = 7) was contaminated with asbestos, 4 of 6 samples from workers car seats were contaminated with asbestos.	Recommendation included leaving contaminated clothing at work and showering before leaving.
Ciarelli et al. [1992] Italy	Asbestos	A variety of work performed by shipyard workers, dock workers and sailors	Review of 170 clinical cases in which necropsies were performed.	5 cases had domestic exposures to asbestos in cleaning the work clothes of their husbands who were employed in shipyards.	
Gibbs et al. [1990] United Kingdom	Asbestos	Shipyard, lagging building and ordinance work	Study of 10 non-occupational cases of mesothelioma	9 cases were due to exposures to asbestos from washing husbands' work clothes.	
Huncharek et al. [1989] USA	Asbestos	Exposure of spouse to contaminated clothing for 34 years.	Post mortem fiber counts from removed lung	Fibers/g of wet lung tissue: Chrysotile 1.72 x 10^3 Amocite/crocidolite 59 x 10^3 Tremolite/actinolite/anthophyllite 221 x 10^3.	Husband was a shipyard machinist whose work clothes became covered with dust. His wife regularly laundered these clothes at home.

Table 15. (Continued) Workers' Home Contamination-Industrial Hygiene Aspects

Author [year] Location	Contaminant Basis for Study	Process	Industrial Hygiene Methodology	Industrial Hygiene Observation	Comments or Recommendations
Kominsky et al. [1990] Ohio	Asbestos	Wet & dry vacuuming to remove asbestos fibers from contaminated carpets and determination of airborne levels during vacuuming.	Transmission electron microscopy was used to analyze air samples collected during vacuuming. An EPA method was used for analysis of carpet samples. Carpets contaminated at 1 million and 1 billion asbestos structures/ft^2. Decontamination by HEPA filtered dry vacuum and hot-water extraction cleaners.	Wet vacuuming reduced carpet contamination by 70%. There was no significant evidence of change following dry vacuuming.	Air concentrations increased 2-4 times during vacuuming compared to prevacuuming levels.
Nicholson et al. [1980] California & Newfoundland	Asbestos	Workers' home contamination from mining and milling asbestos.	Air samples were collected in homes of asbestos workers.	13 Chrysotile asbestos samples ranged from > 50 to > 2,000 < 5,000 ng/m^3.	These are the only measurements of asbestos concentrations in workers' homes.
NIOSH [1971] Ohio	Asbestos	Laundering-transfer of fibers to other clothes and cleaning solution.	An asbestos-containing coat (8% asbestos) was dry cleaned with non-asbestos containing clothes.	Demonstrated substantial transfer of fibers to other clothes and to the dry cleaning fluid.	
Sawyer [1977] Connecticut	Asbestos	Laundry	Air samples collected on membrane filter analyzed by phase contrast microscopy. Samples collected in building laundry, not homes.	Asbestos fibers/cm^3: Picking up clothing 0.4; Loading washer 0.4; Loading dryer 0.0; Personal 0.4 (up to 1.2)	In this asbestos abatement project, controls were substantial so these are probably minimum estimates of many home laundry exposures in the past. Clothes only worn for 4 hours.
Seixas and Ordin [1986] New Jersey	Asbestos	Brake shoe manufacturing	Work clothing was vacuumed as employees left work and dust was analyzed using polarized light microscopy and X-ray diffraction.	Vacuum samples from all work clothes contained chrysotile asbestos fibers. Quantitative data not presented.	Potential for home contamination via clothes brought home by the workers. Provide clean uniform or disposable ones to all employees. Separate soiled work clothes from street clothes.
Abbritti et al. [1989] Italy	Lead	Ceramic factories & workshops at home	Sampling of house dust. Methodology not reported.	Mean lead concentrations in house dust were 2.7 and 4.7 mg/m^2 where workers were exposed in factories and where workshops were adjacent to houses, respectively (vs. 0.8 mg/m^2 in controls).	

Table 15. (Continued) Workers' Home Contamination-Industrial Hygiene Aspects

Author [year] Location	Contaminant Basis for Study	Process	Industrial Hygiene Methodology	Industrial Hygiene Observation	Comments or Recommendations
Apol and Singal [1980] Alaska	Lead	*Lead acid storage* battery manufacturing	*Air sampling in plant*	Personal breathing zone samples (5) ranged from 111 to 1,053 $\mu g/m^3$.	Owner & family lived above plant. Recommended: Installing change room, closing up hallway between plant and home, clean home, and *monitor family* for lead exposure.
Baker et al. [1977] Tennessee	Lead	Secondary lead smelter	Sampled homes for lead content in house dust. Analyzed wipe samples by anodic stripping voltametry.	Dust in workers' homes contained lead at 2,687 ppm (< 1,000-80,000) vs. 404 ppm for controls.	As a result of study, workers homes were cleaned. Workers started showering and changing clothes before going home.
Barnett [1994] Oregon	Lead	Tile manufacturing	Not applicable	1 worker had a blood lead level of 73 $\mu g/dL$.	Investigators think at least one child (of a worker) has high blood lead.
Barnett [1994] Oregon	Lead	Bronze foundry	Not applicable.	2 children of foundry workers had high BBLs (14 & 23 $\mu g/dL$).	Oregon OSHA documented that employees were taking lead dust home on clothes.
Carvalho et al. [1984] Brazil	Lead	Lead smelter	Blood lead samples analyzed via atomic absorption spectrophotometry with heated graphite furnace atomizer.	Children of lead workers had higher blood lead values (67.5 $\mu g/dL$) than other children (56.6 $\mu g/dL$). Lead workers took used *"filters" home from* the plant, for re-use in their home.	
CH2M Hill [1991] Idaho	Lead	Lead smelter	Vacuuming and shampooing; analyses for lead and other metals.	Lead loading in carpets ranged from 12 to 283 mg/ft^2 and in furniture from 57 to 1,100 mg/ft^2, only 14-30% of lead was removed from carpets; 5-40% from furniture.	500 $\mu g/g$ (lead/total dust) action level for cleanup advisory.
Cook et al. [1993] Colorado (Leadville)	Lead	Lead mining and smelting	Work practices questionnaire. Samples of floor dust, window sill dust, paint and tap water were analyzed for lead.	Lead in window sill dust 30-27,900 ppm, floor dust 8-11,000 ppm.	Positive association between miner wearing work clothes home and *BLLs in children.*
Czachur et al. [1995] New Jersey	Lead	*Various lead industries*	Telephone interviewers asked about showering at work, washing clothes at home, etc.	The data indicate that elevated blood lead levels in children are associated with parents washing dirty work clothing at home.	Data collected after June 1992.

Table 15. (Continued) Workers' Home Contamination-Industrial Hygiene Aspects

Author [year] Location	Contaminant Basis for Study	Process	Industrial Hygiene Methodology	Industrial Hygiene Observation	Comments or Recommendations
Dolcourt et al. [1978] See also CDC [1977b] North Carolina	Lead	Battery factory	Carpet vacuum samples	Average concentrations of lead in house dust were 1,700 to 47,534 ppm in 6 homes. Clothes closets demonstrated particularly large degrees of contamination, up to 84,000 ppm. Cars contained lead in dust at an average of 2,770 ppm.	Contaminated work clothing was the probable home lead contamination source; paint, water supply and air were ruled out as sources of lead.
Dolcourt et al. [1981] North Carolina	Lead	Battery recycling. Battery castings were burned as fuel in one family's wood burning stove.	Dust samples collected by vacuum. Decontamination with Calgon®.	Dust from kitchen floor contained lead at 41,283 ppm (13.6 mg/m^2); from bedroom floor 6,800 ppm (3.3 mg/m^2); from living room floor 5,862 ppm (5.9 mg/m^3); from sofa 13,283 ppm. About 5.5% was removed by a single decontamination procedure.	Battery recycling out of the home kitchen.
Donovan [1994a, 1994b] Ohio	Lead	Stained glass studio.	Air samples at work and home. Wipe samples at home and studio. Vacuum carpet at home.	Home-air, home-wipe and carpet-vacuum samples all were below the detection limit. Studio wipe samples = 1.2 to 1,600 mg/m^2. Breathing-zone air samples in studio = 0.1 to 80 $\mu g/m^3$. General-area air samples in studio $\leq$ 2 $\mu g/m^3$; home and outside < 0.1 $\mu g/m^3$.	The studio adjoins the home. Engineering controls & hygiene practices account for low blood lead and low lead in the home. The simple, low-cost control techniques used at the studio could benefit others in the trade. Dog and child not permitted in studio.
Ewers et al. [1994a, 1995] See also Piacitelli et al. [in press] Connecticut	Lead	Abrasive blasting of lead-based-paint from bridge	Wipe samples for lead taken from hands and faces of workers' and smooth surfaces of personal vehicles, vacuum samples of car floor carpets and seats, and gauze patches were attached to workers clothing.	Lead on: unwashed faces 4-1,800 μg/wipe, washed 4-260 μg/wipe; unwashed hands 4-5,600 μg/wipe, washed hands 1-920 μg/wipe; clothing 1-7,700 μg/gauze pad (<1-1,200 $\mu g/cm^2$); cars up to 2,000 $\mu g/cm^2$ on floor, 1,100 $\mu g/cm^2$ on driver's arm rest.	

Table 15. (Continued) Workers' Home Contamination-Industrial Hygiene Aspects

Author [year] Location	Contaminant Basis for Study	Process	Industrial Hygiene Methodology	Industrial Hygiene Observation	Comments or Recommendations
Ewers et al. [1994b] Ohio	Lead	Decontamination of carpets and floors	Carpets-repeated HEPA vacuuming. Wooden floors-dry HEPA vacuuming. Linoleum floors - dry HEPA vacuuming followed by wet washing. Collected dust was analyzed for lead contamination.	Lead concentration in dust remained about the same from first to tenth carpet cleaning. Over 95% of total dust was removed from bare wooden floors after dry HEPA vacuuming only. Dry HEPA vacuuming removed over 75% of total dust from linoleum floors. Wet washing removed an additional 20%.	Lead loading on carpet surface may increase if vacuuming is not done for sufficient time. It may be more practical to replace rather than clean contaminated carpets.
Fischbein et al. [1992] USA	Lead	Home pottery work	Blood lead	BLL: worker 48 $\mu g/dL$, daughter 54 $\mu g/dL$, spouse normal. Art studio was separated from the family home by a curtained-off studio. Daughter (5-years-old) spent significant time in studio with artist mother.	The family was asked to discontinue potential exposure to lead in the studio; 2 years later blood lead concentrations were normal.
Gittleman et al. [1991, 1994] Alabama	Lead (Pb)	Battery recycling	Wipe samples in employee autos. Work practices observations.	Workers did not consistently shower and change clothes before leaving work. 3 mg Pb/100 cm^2 on drivers seat 1.9 mg Pb/100 cm^2 on driver's floor area. 1.7 mg Pb/100 cm^2 on dashboard.	
Grandjean and Bach [1986] Denmark	Lead	Secondary lead smelter	Airborne lead in socks	When air lead < 0.1 mg/m^3, socks contained 0.13-1.62 g lead/pair. When air lead > 0.1 mg/m^3, socks contained 0.06-2.19 g lead/pair.	Indicates that all clothes worn at work should not be taken home.
Gunter et al. [1987] Colorado, Nevada	Lead	Fire assay procedures	Air sampling for lead dust & fume.	General room air contained lead up to 600 $\mu g/m^3$.	The report recommends that the workers should shower and change clothes before leaving the workplace to prevent exposure of family members to lead-contaminated work clothes.

Table 15. (Continued) Workers' Home Contamination-Industrial Hygiene Aspects

Author [year] Location	Contaminant Basis for Study	Process	Industrial Hygiene Methodology	Industrial Hygiene Observation	Comments or Recommendations
Kawai et al. [1983] Japan	Lead	Cottage industries: quench-hardening & type-printing.	Air and surface sampling of dust in 2 homes where family members had elevated BLL.	Air in workshop: 2 to 50 $\mu g/m^3$ Surface: 260 to 20,386 ppm of lead in total dust. Workshop surfaces: Floor 3,000 to 20,000 ppm Desk 4,500 ppm Window frame 1,400 ppm. Living area surfaces: Carpets 1,000 to 5,000 ppm Window frame 260+ ppm Television 380 ppm Dining room floor 678 ppm.	
Kaye et al. [1987] Colorado	Lead	Electronics components plant making ceramic-coated capacitors & resistors.	Workplace area samples contained lead at 60-1,700 $\mu g/m^3$. Dust samples were taken from vacuum cleaners of both worker and non-worker homes, and were analyzed for lead content.	Lead in 11 dust samples from workers' homes, ranged up to 3,400 ppm, and in 9 samples from non-worker homes it ranged from up to 320 ppm.	No protective clothing or worksite showers were used to prevent dust from being taken home from the plant.
Kelly [1994] Ohio	Lead	Manufacturing of pewter products	Dust samples from carpets, window sills, automobiles, soil and exterior surface dust of 3 workers' homes.	Carpets: 625 to 7,200 ppm Other floors: 800 to 3,700 ppm Window sills: 1,700 to 25,000 ppm Auto floor carpet: 700 ppm Exterior dust & soil: < 16 to 8,200.	
Koplan et al. [1977] Barbados	Lead	Pottery cottage industry leadglazing	22 wipe samples of dust in work and living areas of 6 dwellings.	20 samples had lead in dust > 1,000 $\mu g/g$; 13 samples from living areas averaged 5,000 $\mu g/g$. Lead in dust ranged from 393 $\mu g/g$ from a floor in the dining room in one home to 325,892 $\mu g/g$ from a table surface where glazing was done.	
Landrigan et al. [1980] Georgia	Lead	Stained glass window production in commercial studios	Lead levels in bulk-dust samples in 1 home and 1 studio.	Mean lead concentration in studio (3 samples) was 10,696 ppm. Mean concentration in home (2 samples) = 355 ppm.	
Lundquist [1980] USA	Lead	Manufacturing of lead batteries.	Informing workers of hazards of home contamination and preventive measures.		

Table 15. (Continued) Workers' Home Contamination-Industrial Hygiene Aspects

Author [year] Location	Contaminant Basis for Study	Process	Industrial Hygiene Methodology	Industrial Hygiene Observation	Comments or Recommendations
Martin [1974], Martin et al. [1974] United Kingdom	Lead	Smelters, lead and other mines.	Lead in clothing and automobiles.	Lead was found in underclothing, socks, boots and cars of workers, data were not reported.	Factory managers were asked to assure that workers used the cleaning facilities available so that they did not take lead dust home on their bodies, clothing, and footwear.
Matte and Burr [1989]; Matte et al. [1989] Jamaica	Lead	Cottage industry: "backyard battery repair shops"	Air, dust, and soil	Lead in air, geometric mean = 21 $\mu g/m^3$ in workshops. Lead in household dust, range = 190 to 53,140 $\mu g/m^2$. Lead in soil, 51 to 400,000 ppm.	Changing work clothes was not associated with lower house dust lead levels. None of the facilities surveyed had adequate shower and changing facilities. Threshold for soil lead = 500 ppm; for house dust 1,500 $\mu g/m^2$. Playing in shop area was associated with higher BLLs in children.
Matte et al. [1991] Jamaica	Lead	Conventional & cottage lead smelters	House dust and soil samples from cottage smelters. Dust samples collected from floor of room in which children spent most of their time.	Lead in house dust, 100 to 109,000 $\mu g/m^2$; in soil, 9 to 320,000 ppm.	
McCammon et al. [1991] Utah	Lead	Lining of 2 large tanks with lead sheets.	Wipe samples for surface lead including employees' street shoes and in employees' cars.	Lead on boots and shoes 1-20 $\mu g/cm^2$; on shirt collars 0.3-2 $\mu g/cm^2$; on floor of cars 0.3-4 $\mu g/cm^2$.	The authors state: "The opportunity for lead exposure was likely increased by the lack of shower facilities & the practice of wearing work clothes at home." Recommendation: install clean & dirty change rooms, and provide laundry facilities at work.
Menrath et al. [1993] USA	Lead	Mining	Dust samples collected from the cars & homes of both miners & non-miners in the same community.	Mean lead concentrations in dust = 3,909 ppm in miners cars vs. 917 ppm in non-miners cars. Lead loadings on car floors = 3,539 $\mu g/ft^2$ for miners vs. 565 $\mu g/ft^2$ for non-miners. Lead loadings in homes were similar for both groups, approx. 56 $\mu g/ft^2$. Concentra- tion of lead in house dust was higher for miners.	

Table 15. (Continued) Workers' Home Contamination-Industrial Hygiene Aspects

Author [year] Location	Contaminant Basis for Study	Process	Industrial Hygiene Methodology	Industrial Hygiene Observation	Comments or Recommendations
Milar and Mushak [1982] North Carolina	Lead	Home contamination of carpets containing 1,152-11,148 ppm of lead	Calgon® solution in Steamex® carpet cleaner followed by detergent cleaner 24 hours later.	Detergent cleaning alone had little effect on lead expressed either as ppm in dust or lead in $\mu g/m^2$. Calgon® treatment followed by detergent reduced contamination by 60% on the average.	Details of decontamination procedure are given. Effectiveness demonstrated by concomitant reduction in child's blood lead.
CDC [1977b] See also Dolcourt et al. [1978] North Carolina	Lead	Battery factory	Lead in air, dust, paint & drinking water from 7 workers' homes and soil samples from cars that were driven to work.	No lead contamination in paint or water and no airborne lead exposures from factory emissions or busy roadways. Lead in house dust 1,695 to 84,074 $\mu g/g$. Highest levels were from closet where work clothes were stored (mean 31,840 $\mu g/g$). Mean lead level in dust from cars was 2,770 $\mu g/g$.	The employer made changes to reduce worker & family exposures, including exhaust ventilation, providing coveralls & improved shower facilities. Contaminated homes were thoroughly cleaned.
CDC [1992a] Utah	Lead	Welding and soldering with lead	Wipe samples.	Shoes had lead at 4-20 $\mu g/cm^2$. Floor of car had lead at 4 $\mu g/cm^2$.	
Morton et al. [1982] Oklahoma	Lead	Battery making	Questionnaires designed to ascertain potential lead exposure in homes.	Blood lead levels in children related to workers' potential for exposure to lead and to work practices.	The authors recommend controls: showering, shampooing, changing clothes and shoes before leaving work. They also noted that only changing clothes did not reduce the risk.
Nelson and Clift [1992] Oklahoma	Lead	Foundry	Samples were collected from homes of foundry & non-foundry workers in a rural town. Samples collected included dust from carpeting, dash of work vehicle, and clothing. Samples were analyzed by atomic absorption with a graphite furnace.	Lead was detected in all homes with levels in carpets ranging from 105 ppm to 1,535 ppm.	
Osorio [1994] California	Lead	Cutting down lead-sheathed cable	Lead in worker's home and yard.	Lead in backyard soil at 1,500 $\mu g/dL$; lead in indoor housedust at 1,700 ppm.	Worker wore dirty clothing home and laundered it with family laundry. Also took lead-contaminated used telephone poles home for fire wood.

Table 15. (Continued) Workers' Home Contamination-Industrial Hygiene Aspects

Author [year] Location	Contaminant Basis for Study	Process	Industrial Hygiene Methodology	Industrial Hygiene Observation	Comments or Recommendations
Piacitelli and Whelan [1995] Ohio	Lead	Bridge repair	Wipe and vacuum samples for dust in automobiles and homes of workers. Samples of loose paint and water supply analyzed for lead.	Lead loading ($\mu g/m^2$): Main entry floor, 2,031 Change area floor, 2,278 Washing machine lid, 801 Sofa/chair, 639 Driver's seat, 5,647 Floor of car, 10,653 Steering wheel, 790 Worker's hands, 3,131 Family member's hands, 140	Data from homes with lead in paint > 0.5% excluded.
Piacitelli and Rice [1993] Ohio	Lead	Radiator repair shops	Surface wipe sampling of workers' cars, hands and foreheads. Evaluation of hand washing.	Lead in cars up to 96,000 $\mu g/m^2$; on foreheads of workers, 6,000 $\mu g/m^2$; on unwashed hands, 78,050 $\mu g/m^2$; average on unwashed hands, 678 $\mu g/m^2$; after washing hands, 593 $\mu g/m^2$.	
Piacitelli et al. [in press] See also Ewers et al. [1994a, 1995] Connecticut	Lead	Bridge work: lead-based paint abatement	Wipe and vacuum samples were collected in 27 automobiles of abrasive blasters and other lead-exposed workers.	Lead contamination was found in all automobiles. The mean lead loading was lower in abrasive blasters' cars than in other workers' cars: 370 $\mu g/m^2$ vs. 2,000 $\mu g/m^2$. Lead loadings on floors and seats of cars were 340-2,000 $\mu g/m^2$ and on other surfaces < 500-1,900 $\mu g/m^2$.	Abrasive blasters regularly changed out of work clothing and showered before entering their cars, whereas the other workers did not. Half the workers regularly had child passengers.
Pichette et al. [1989] Texas	Lead	Battery manufacture Battery manufacture/Battery recycling Battery recycling	BLL of spouse and other adult household members by laundry practice.	When laundered by: company BLLs were 8.4 $\mu g/100$ mL; spouse, 13.0 $\mu g/dL$; other household member, 15.6 $\mu g/dL$.	
Pitts [1986] Garrettson [1988] Virginia	Lead	Radiator repair	Wipe samples of lead in dust at home and in car; area sampled not reported.	Lead (μg/filter) in: Bathroom closet, 183 Kitchen floor, 284 Floor board of car, 7,580 Driver's seat, 1,295 Workers Shoes, 11,030	Living room paint had lead at 0.03%; yard soil had lead at 39 ppm. The father did not change clothes or shower at his work site. The highest lead level in the house was near the washing machine. Children frequently played in the car.

Table 15. (Continued) Workers' Home Contamination-Industrial Hygiene Aspects

Author [year] Location	Contaminant Basis for Study	Process	Industrial Hygiene Methodology	Industrial Hygiene Observation	Comments or Recommendations
Pollock [1994] Mississippi	Lead	Trucking lead and lead products	Lead in dust at home.	Lead found on surfaces in home up to 20 $\mu g/ft^2$; on worker's shoes at 240 $\mu g/ft^2$.	200 $\mu g/ft^2$ is limit for dust on floors. Change clothes & shoes before entering home, wash work clothes separately, clean or wash floors, carpets, furniture and toys.
Que Hee et al. [1985] Ohio	Lead	Not applicable	Method development for sampling & analysis of house dust and hand contamination.	Recovery of lead dusts from surfaces by single vacuuming was 74%, by five vacuumings, 100%. Recovery of lead from hands by single wipe was 52%, by five wipes, 100%.	
Rice et al. [1978] USA	Lead	Secondary lead smelters	Wipe samples of dust collected in workers' homes and control homes.	Lead content of wipe cloths in workers' homes, 79-112 μg; control homes, 10-29 μg. Lead concentration in settled dust, 3.31 $\mu g/m^2$ in workers' homes; 1.24, in control homes.	More stringent work practices & personal hygiene are required.
Rinehart and Yanagisawa [1993] See also Venable et al. [1993] Massachusetts	Lead, tin	Electric cable splicing Workers' homes contamination measurements compared to control homes	House dust samples collected with a hand-held vacuum, analyzed by X-ray fluorescence.	Laundry areas of workers' homes, 621-1,606 ppm of lead in dust; control homes, 9-1,212 ppm. Other areas of workers' homes, 227-909 ppm of lead in dust; control homes, 121-879 ppm. Tin in workers' homes: laundry areas, 73-242 ppm; other areas, 45-115 ppm. Tin in control homes: laundry areas up to 73 ppm; other areas not detected.	Since workers' exposures to lead were below the OSHA PEL, workers washed their soiled clothes at home.
Sherlock et al. [1985] United Kingdom	Lead	Lead levels in Caucasian and Asian children	BLLs and hand washing practices.	Children who washed hands before eating had lower BLLs levels than children who did not.	Children should be encouraged to wash hands before eating.
Simonson and Mecham [1983]	Lead	Smelter	Evaluation of airshowers and automatic shoe cleaners for lead removal from clothing.	Air shower removed 5 to 72% of lead from clothing. No quantitative data reported for shoe cleaners.	Some penetration of lead to underclothes.

Table 15. (Continued) Workers' Home Contamination-Industrial Hygiene Aspects

Author [year] Location	Contaminant Basis for Study	Process	Industrial Hygiene Methodology	Industrial Hygiene Observation	Comments or Recommendations
State of Alabama [1992] Alabama	Lead	Pottery making, cottage industry	Lead wipe samples in home and workshop.	Wipe samples in mobile home = 16 to 390 $\mu g/ft^2$, in workshops 440-177,000 $\mu g/ft^2$.	Author notes HUD interim guidelines for clearance criteria for specific indoor surfaces: floor = 200 $\mu g/ft^2$; window sills = 500 $\mu g/ft^2$; window wells = 800 $\mu g/ft^2$. Grandmother's living quarters should be moved from the ceramic/pottery shop. Make shop off limits to family's children. Shower and change into clean clothes before entering house.
Venable et al. [1993] Massachusetts	Lead	Cable splicing in a utility company	Air sampling. Wipe samples from surfaces, employee clothing, boots, and hands before and after washing.	TWA exposures to lead at 0.22 to 17 $\mu g/m^3$, below OSHA PEL (50 $\mu g/m^3$). Lead loadings: Service vehicles 48-12,400 $\mu g/ft^2$; clothes 600-4,800 $\mu g/ft^2$; hands before washing 1,800-4,900 $\mu g/ft^2$; after 250-680 $\mu g/ft^2$.	Although most employees showered and changed clothes at the end of the day 91% took work clothes home and 22% washed work clothes and other laundry together.
Watson et al. [1978] Vermont	Lead	Battery manufacturing	Lead samples in homes; lead in house dust, drinking water and paint. Dust samples analyzed via an anodic stripping voltmeter, lead paint samples were analyzed by an X-ray source detector, and water samples were analyzed via atomic absorption spectrophotometry.	Households of workers had higher concentrations of lead in dust (2,239 ppm) than controls (718 ppm).	Authors note that even with a plant program of showering and changing clothes, apparently enough lead reaches the workers homes (on hair, skin, clothing) to result in higher lead levels. Recommendation that plant provide laundered uniforms at work.
Wiehrdt [1994] Indiana, Illinois, Ohio	Lead	Not identified	OSHA learned that 6 children of workers had elevated lead levels, and conducted wipe samples in children's homes.	Lead in wipe samples ranged up to 240 μg/wipe.	

Table 15. (Continued) Workers' Home Contamination-Industrial Hygiene Aspects

Author [year] Location	Contaminant Basis for Study	Process	Industrial Hygiene Methodology	Industrial Hygiene Observation	Comments or Recommendations
Winegar et al. [1977] Minnesota	Lead	Secondary lead smelter	Lead in household dust and clothing.	Lead in household dust from 25 households ranged from 120 to 26,000 ppm (2,400 ppm median). Lead in dust and cloth from cuffs of pants worn under coveralls was 60,000-600,000 ppm, and 700-19,000 $\mu g/2.5\ cm^2$ respectively.	One of 33 workers showered at work, 8 took work clothes home for cleaning, 21 took home clothes worn under coveralls.
Devries and Devries [1993] Ontario, Canada	Caustic farm products	Farming	Developed a cover for drums of acid, soap, and chlorine cleaner used on farm.		Published design in "Hoard's Dairyman" for wide distribution to dairy farmers.
Jorgenson [1990] Wisconsin	Caustic farm products	Farming	Precautions needed to prevent poisoning of children	Preventive measures include guidelines of storage and use.	Information published in "Wisconsin Dairies" for distribution to Wisconsin Dairies Cooperative members.
Morris and Morris [1992, 1993] New Hampshire	Caustic farm products	Dairy farms	Developed secure storage box for caustic substances.		Published description of box in "Hoard's Dairyman" and "Farm Journal" for dissemination to a wide audience.
Anderson et al. [1965] Canada	Parathion	Salvage Operation Sheets contaminated in hold of ship during transport	Strips of material analyzed for parathion	Flannelette sheets contaminated with parathion.	Owner operated salvage business from home and used sheets purchased from insurance company for home use.
Barnett [1994] Oregon	Chloropicrin	Wood treating	Not applicable.	Containers of pesticide dropped on employee's driveway. Wind carried vapors next door.	As result of accident, employer no longer allowed employees to take company cars home.
Branson and Henry [1982] Michigan	Pesticides	Pesticide application	This is an extension bulletin alerting pesticide users of potential hazard and precautions for workers and families.		Recommends cleaning clothes after every use, keeping contaminated clothing separate from other clothing, and using an extra rinse.

Table 15. (Continued) Workers' Home Contamination-Industrial Hygiene Aspects

Author [year] Location	Contaminant Basis for Study	Process	Industrial Hygiene Methodology	Industrial Hygiene Observation	Comments or Recommendations
Cannon et al. [1978] Virginia	Kepone	Manufacture	Kepone in whole blood. Interviews.	Kepone in blood of family members 0.003-0.39 ppm; other residents 0.005-0.033 ppm.	2 women who washed husbands clothes developed symptoms of kepone poisoning.
Clifford and Nies [1989] Colorado	Ethyl parathion	Manufacture	Laundry	After spill, uniform was washed twice and still contained parathion at 70,000 ppm; clothes washed with it contained 135-150 ppm.	Potential poisoning of family members was avoided because company routinely laundered work clothes.
Finley and Rogillio [1969] Louisiana	1,2-bis-(p-Chlorophenyl)-2,2,2-trichloroethane (DDT) and methyl parathion	Cotton field work in treated fields	5 shirting-type fabrics were worn in the field for 8 hours.	Up to 12 ppm of methyl parathion and 136 ppm of DDT were found in the exposed fabrics.	
Finley et al. [1979] Louisiana See Satoh [1979]	Pesticide (methyl parathion)	Cotton field work in treated fields	Cotton & cotton/polyester blends were worn by workers into a cotton field treated with methyl parathion. Samples were collected on 1st, 2nd, and 4th days after spraying.	All-cotton fabric residue concentrations (21 ppm on day 1) were 49-68% of the cotton-blend residues (35 ppm on day 1). Clothing contamination level on day 4 was 1% of that on day 1. Undergarments attained 55% of the outer garment residue levels.	Recommended delaying reentry to day 4 and wearing 2 layers of clothing.
Ganelin et al. [1964] Arizona	Parathion	Pesticide application	Case studies	Non-fatal poisonings of pesticide application workers exposed to equipment previously used for organophosphorus insecticide application.	All equipment which has been used for application or handling of toxic insecticides must be considered contaminated and dangerous until a thorough decontamination is performed. Such equipment should be kept in areas forbidden to those who are uninformed of hazards.
Graves et al. [1980] Louisiana	Permethron	Farming	Fabrics worn for 6 hours in cotton field.	Fabrics contained permethron at about 25 ppm.	

Table 15. (Continued) Workers' Home Contamination-Industrial Hygiene Aspects

Author [year] Location	Contaminant Basis for Study	Process	Industrial Hygiene Methodology	Industrial Hygiene Observation	Comments or Recommendations
Lavy [1988] Arkansas	Herbicides		Informing applicators of hazards and protective measures.		Included in this advisory are recommendations for preventing contamination of the home.
Lewis et al. [1994] North Carolina	Pesticides	Home Contamination	Sampling for 30 pesticides in carpets in 9 residences.	A total of 23 pesticides were found. From 8 to 18 pesticides were found in each home.	Demonstrates need to consider many sources when evaluating workers' homes.
Oakland et al. [1992] North Carolina	Atrazine	Crop-spraying	Atrazine contamination of sprayer's clothing after 4 hours of work.	Atrazine at up to 7 $\mu g/cm^2$.	
Osorio [1994] California	Pesticides	Farming	Sampled for pesticides in 5 farm workers' homes and 6 non-farmworkers' homes.	In all, 15 pesticides were found in the study. Diazinon, chlorpyrifos and propoxur were found at much higher concentrations in farm workers' homes.	Sources of pesticides (air, clothing, shoes) was not determined.
Stone and Stahr [1989] Iowa	Pesticides	Farming	Analysis of applicator's coveralls for pesticides.	Measurable levels of 5 pesticides found even though the coveralls had been washed after each use.	Demonstrates the difficulty of removing pesticides from fabrics by laundering.
Ware et al. [1973] Arizona	Ethyl and methyl parathion	Farming	Measured contamination of clothing from working in treated cotton fields for 30 minutes.	Blue jeans contained methyl parathion at 6-16 mg/pair and ethyl parathion at about 8 mg/pair. T-shirts contained < 1 mg.	
Wolfe et al. [1961] Washington	Parathion	Agriculture	Analysis of parathion in empty metal drums and effect of rinsing.	After first rinse water contained parathion from 3 to 33 g/gal; after 4 rinses, < 0.15 g/gal.	
Fischbein [1987] USA	Polychlorinated biphenyl (PCB)	Transformer maintenance Home laundry	Serum PCBs in 2 workers and their wives.	One worker's serum PCB level, 69-101 ng/mL; wife's 11-15 ng/mL. Other worker's serum PCB level, 77 ng/mL; wife's 6 ng/mL. In both cases PCB pattern was same as husbands.	The author recommended "appropriate industrial hygiene measures" to prevent home contamination from occupational sources.

Table 15. (Continued) Workers' Home Contamination-Industrial Hygiene Aspects

Author [year] Location	Contaminant Basis for Study	Process	Industrial Hygiene Methodology	Industrial Hygiene Observation	Comments or Recommendations
Hartle et al. [1987] Indiana	Polychlorinated biphenyl (PCB)	Aluminum extrusion using PCB contaminated hydraulic fluids	Wipe samples	Wipe sample results up to 900 μg PCB/m^2. Hand wrench 308 μg PCB/m^2. Lunch pail 14 μg PCB/m^2. Gloves 36-160 ppm PCB.	NIOSH proposed a wipe-sample limit 50-250 $\mu g/m^2$ for low contact surfaces. Change room & company laundered coveralls were recommended.
Hartle [1987] Pennsylvania	Polychlorinated biphenyl (PCB)	Maintenance workers working in PCB-contaminated building in a rail yard	Wipe samples with hexane moistened gauze pads.	Wipe samples from bottom of maintenance pit averaged 90,000 μg PCB/m^2. Other wipe samples indicated PCB contamination on floors of lunch room, locker rooms, supply room, and foreman's office.	Wipe sampling of clothes and worker-owned tools were not allowed. The workers might have also contaminated their own homes from clothes, shoes and personal tools taken home with them.
Kominsky [1987a] Florida	Polychlorinated biphenyl (PCB)	Firefighting at a transformer oil reclamation facility. Decontamination of protective clothing.	PCBs extracted from pre-wash samples using toluene. Samples of incident-contaminated clothing & "spiked" clothing. Detergent and water wash. RADKLEEN® clothing decontamination system with Freon®.	After soap and water wash PCB's in clothing 15-1,060 $\mu g/g$. After RADKLEEN® treatment PCB's 1.8-25 $\mu g/g$ in incident-contaminated clothing. RADKLEEN® efficiency was 66 to 99% for incident-contaminated and >90% for "Spiked" samples.	Safe level of PCB's in clothing not known.
Orris and Kominsky [1984] Minnesota	Polychlorinated biphenyl (PCB)	Transformer fire at a school	Wipe samples at a school. Decontamination of surfaces by washing with liquid alkaline synthetic detergent.	Initial surface contamination < 0.05 to 20 $\mu g/100cm^2$. Some surfaces required 2 washes.	PCBs were not detected after cleaning.
Price and Welch [1972] Michigan	Polychlorinated biphenyl (PCB)	General population	Human tissue analyses House-dust samples from homes of workers occupationally exposed to PCBs.	PCBs were found in human tissues during autopsies. Several house-dust samples contained up to 180 ppm PCBs.	
Doherty [1984] Missouri	Dioxin (2,3,7,8-tetrachlorodibenzodioxin)	Community contamination	Soil samples Carpet samples inside house Post clean-up vacuum samples Replaced carpet	Dioxin in soil 48 ppb in front of house; 2.6 ppb in carpet, post clean-up. Dioxin in vacuum dust less than lab detection limit.	

Table 15. (Continued) Workers' Home Contamination-Industrial Hygiene Aspects

Author [year] Location	Contaminant Basis for Study	Process	Industrial Hygiene Methodology	Industrial Hygiene Observation	Comments or Recommendations
Hess [1988] Missouri	Dioxin 2,3,7,8-tetrachlorodibenzodioxin	Decontamination of structures contaminated with dioxin from waste oil used in dust suppression.	Residence and one commercial building were cleaned with HEPA equipped high-efficiency vacuum and every inside surface wiped with a damp cloth and detergent wash.	Residences were satisfactorily cleaned (<4.0 pg/cm^2) commercial building contamination reduced from 36.6 ppb to 13 ppb.	Additional decontamination of commercial building included removal of attic insulation and floor replacement.
Jensen et al. [1972b] United Kingdom	2,3,6,7-Tetrachlorodibenzodioxin	Trichlorophenol plant refitting a previously cleaned tank		Two employees, one employee's son & other employee's wife developed chloracne.	The equipment had been contaminated 3 years earlier, and repeatedly steam cleaned. Employees must have contacted a pocket of residual material.
ATSDR [1991b] Michigan	3,3'-Dichlorobenzidine (DCB)	DCB production	Sampled workers' home for DCB in vacuum cleaner bags and dryer lint.	DCB up to 10.5 ppm was found in vacuum cleaner bags & up to 0.74 ppm in dryer lint. DCB was found in urine of some workers & family members.	
ATSDR [1989b] Michigan	4,4'-methylene-bis(2-chloroaniline) (MOCA)	Plastics manufacture	Vacuum cleaner dust and clothes dryer lint in workers' homes analyzed for MOCA.	MOCA up to 2.6 ppm in vacuum dust and 0.65 ppm in dryer lint.	MOCA in urine of family members up to 12.1 ppb.
Bagnell and Ellenberger [1977] North Carolina	Tetrachloroethylene (perchloroethylene)	Suede and leather dry cleaning	Gas chromatography headspace procedure of breast milk & venous blood samples.	Mother often ate lunch with husband (30-60 min) in dry cleaning plant.	Evidence suggests that the baby was exposed via breast milk.
Clapp et al. [1985] Pennsylvania	4,4'-methylene-bis(2-chloroaniline) (MOCA)	Urethane casting	Air samples Surface wipes Hand contact monitors Urine samples	Except for 2 surface wipes which had MOCA > 5.3 μg/wipe, measurements were below detection level. However urine samples for 6 workers ranged from 2 to 36 μg MOCA/L.	Company should issue and launder clothing daily, including underwear, require showering before going home. Shoes and disposable shoe covers should be provided.
Schreiber et al. [1993] New York	Tetrachloroethylene	Dry cleaning	Air sampling in apartments above dry cleaning establishments.	Tetrachloroethylene at 100-440 μg/m^3 in apartments above dry-to-dry units, 1,350-17,000 μg/m^3 above transfer units.	Although workers' families were not identified as living in the apartments, such a "cottage industry" situation could exist.

Table 15. (Continued) Workers' Home Contamination-Industrial Hygiene Aspects

Author [year] Location	Contaminant Basis for Study	Process	Industrial Hygiene Methodology	Industrial Hygiene Observation	Comments or Recommendations
Stasiuk [1993] (see also Schneider et al. [1993] New York	Perchloroethylene (PCE)	Dry cleaning	Survey of dry-cleaning establishments	18% (471) of dry cleaners in New York State are in residential buildings. PCE concentrations ranged from 15 to 197,000 $\mu g/m^3$ in apartments above dry cleaners using transfer machines, 160-55,000 $\mu g/m^3$ above vented dry-to-dry machines, and 6-1,910 $\mu g/m^3$ above non-vented dry-to-dry machines.	
ATSDR [1990a] See also ERM Southeast Inc. [1989] Tennessee	Mercury	Chlor-alkali Chemical plant Workers' homes contaminated	Decontamination method not described	Initial mercury concentration in 6 homes was 0.92(<2.0-5.0) $\mu g/m^3$; 1.0-5.0 $\mu g/m^3$ in living quarters of 45 homes. 54 $\mu g/m^3$ over washing machines, 7 $\mu g/m^3$ over sinks, and 8-10 $\mu g/m^3$ in workers' cars. After decontamination concentrations in homes were 0 to 0.5 $\mu g/m^3$.	Vacuuming and floor washing were risk factors for increased mercury absorption by workers' wives.
Benning [1958] Ohio	Mercury	Carbon-brush manufacturing		Plant had poor housekeeping, no ventilation, no shower facilities or change of work clothing policy so that "workers could not avoid taking a certain amount of contaminant home."	Provide cotton smocks, clean at start of work shift, to be left at plant each day and laundered.
Danziger and Possick [1973] New Jersey	Mercury	Scientific glassware manufacturing; calibration of glassware.	Observation	Mercury particles became embedded in workers' clothing, especially in knitted fabric. Some female workers would shake mercury out of their clothes when they arrived home.	The authors recommend that workers not wear knitted clothing and that they wear impervious aprons.
Ehrenberg et al. [1986] Vermont	Mercury	Thermometer and glass production for scientific use.	Flame absorption spectroscopy	The NIOSH trailer which workers entered for medical exams became contaminated; air samples (N=2) contained mercury at 23.4 and 21.5 $\mu g/m^3$.	The measurements obtained in the NIOSH trailer suggest the possibility of offsite mercury contamination via workers inadvertently carrying mercury home on their clothes, shoes, hair, or skin.

Table 15. (Continued) Workers' Home Contamination-Industrial Hygiene Aspects

Author [year] Location	Contaminant Basis for Study	Process	Industrial Hygiene Methodology	Industrial Hygiene Observation	Comments or Recommendations
ERM Southeast Inc. [1989] See also ATSDR [1990a] Tennessee	Mercury	Protocol for mercury decontamination of workers' contaminated homes.	Jerome 511 mercury vapor analyzer & dosimeter. Jerome 431 instantaneous mercury vapor monitor. Use of Nilfisk® mercury vacuum system and mercury binding solution.		0.5 $\mu g/m^3$ were used as clean/non-clean threshold.
Hudson et al. [1985, 1987] Vermont	Mercury	Thermometer manufacture	Air sampling in workers' homes.	Mercury-in-air of living area: Workers homes 0.02-10 $\mu g/m^3$ (median 0.24 $\mu g/m^3$); Control homes 0.01-1 $\mu g/m^3$ (median 0.05 $\mu g/m^3$).	All workers brought work clothes and shoes home. Some elevations of mercury in places where work clothes and shoes were found and in some washing machines.
NIOSH [1973]	Mercury	Various	NIOSH Criteria Document	Reviewed reports of workers' home contamination.	Recommended showering, and changing and washing clothes at work.
Trost [1985] Vermont	Mercury	Thermometer plant		State inspectors found mercury contamination in over half of 50 workers' homes. One home had over 4 times the levels allowed at work.	New York times story of mercury transport via workers' clothing/shoes to homes.
West and Lim [1968] California	Mercury	Milling cinnabar ore		Authors stated that miners had contaminated their homes from their boots and work clothes.	
Zalesak [1994] California	Mercury	Gold mining	Air sampling in workers' homes, cars, and inside plastic bags containing work clothing.	Mercury at 0.005-0.5 mg/m^3 near washer and dryer, 0.03-0.06 mg/m^3 in cars, documented contamination of work clothing.	Employees wearing work clothing home contaminated their cars and homes.
Aw et al. [1985] Indiana	Zeranol (an animal growth hormone)	Pharmaceutical formulator	Air, surface wipes, dermal patches, clothing pieces analysis of above via high pressure liquid chromatography.	Employee's work clothing contaminated with 32 mg of zeranol, employee's skin also contaminated. Workers often wore work clothes and shoes home, and laundered clothes at home.	Recommended showering and changing clothes before leaving work.

Table 15. (Continued) Workers' Home Contamination-Industrial Hygiene Aspects

Author [year] Location	Contaminant Basis for Study	Process	Industrial Hygiene Methodology	Industrial Hygiene Observation	Comments or Recommendations
Katzenellenbogen [1956] Israel	Diethylstilbestrol Signs of estrogen poisoning in workers and families	Production of diethyl-stilbestrol in pharmaceutical factory. Wearing dirty clothes home	Established control procedures including sufficient ventilation, gloves, respirators, special shoes and clothing, showers, and laundry procedures.	Health effects reduced by control procedures.	
Pacynski et al. [1971] Poland	Diethylstilbestrol	Manufacturing	Observation of work practices including taking potentially contaminated food home. Institution of improved industrial hygiene.	Hyperestrogenism in workers and children disappeared after installation of controls.	
Venables and Newman-Taylor [1989] United Kingdom	Rat allergen Platinum salts	Animal handling in laboratory Use of platinum salts in industrial laboratory		In both cases, one spouse was allergic to the allergen brought home on the clothing of the other spouse.	Symptoms resolved after workers changed clothes and showered before leaving work.
Klemmer et al. [1975] Hawaii	Arsenic	Homes treated with pesticides against termite infestations, and homes with pretreated lumber, homes with workers exposed to arsenic.	Concentration of arsenic in household dust from vacuums after filtering through a 0.246 mm size sieve. Analyzed via spectrophotometry.	Arsenic content ($\mu g/g$ dust) in untreated homes without exposed worker 1.1 to 31.0; with exposed worker 5.2 to 1,080. Arsenic content of treated homes without exposed worker 3.0 to 6.4; with exposed worker 8 to 380.	Arsenic may have been brought home on clothing of some exposed workers.
Schneider [1986] Schneider et al. [1989]	Man made mineral fibers (MMMF) and non-MMMF	Surveys in office buildings and schools	Surface and finger sampling for fibers. A method was developed to measure settled fibers from hard surfaces.	Fiber counts on fingers before exposure to dusty surfaces were 0-1 f/cm^2, after exposure, 1.5-82 f/cm^2.	
Litzistorf et al. [1985]	Fibers	Not applicable	Study of human activities affecting airborne fiber concentrations in non-occupational environments in a classroom.	Demonstrated a large increase in fiber concentration in air during vacuuming.	

Table 15. (Continued) Workers' Home Contamination-Industrial Hygiene Aspects

Author [year] Location	Contaminant Basis for Study	Process	Industrial Hygiene Methodology	Industrial Hygiene Observation	Comments or Recommendations
Masek et al. [1972] Czechoslovakia	3,4-Benzo(a)pyrene	Pitch coking plant.	3,4-Benzo(a)pyrene in workers clothing.	3,4-Benzo(a)pyrene in underwear (pants) 31-930 $\mu g/g$; (shirts) 410-1,100; in work clothes (pants) 7,760-35,000 $\mu g/g$; in shirts 1,400-14,000 $\mu g/g$. In washed clothes 12-594 $\mu g/g$.	Author states that current washing method does not ensure effective removal of contaminant. Residual contaminant after washing increases with time of use, 41 $\mu g/g$ at 2 wks, 315 $\mu g/g$ at 12 months.
Versen and Bunn [1989] USA	Diatomaceous earth	Mining, processing, packaging diatomaceous earth. Laundering of work clothing in employees homes.	Air sampling in laundry area of home and outside home. Analysis via X-ray diffraction.	Total dust 0.02-0.06 mg/m^3 inside home, 0.02-0.08 mg/m^3 outside home. Silica was detected but amount was below quantitation level.	
Weeks et al. [1976]	Aromatic amines	Not applicable	Method development--chemical spot tests (visualization & UV detection).	The spot tests can detect low levels of aromatic amines on surfaces: on paint 5-150 ng/cm^2; on metal 15 ng/cm^2; smooth concrete 500-5,000 ng/cm^2, rough concrete 200-5,000 ng/cm^2.	
Woody et al. [1986] Arkansas	Cyclotrimethylene trinitramine (RDX)	Explosives manufacture			Mother reported seeing child chewing on clumps of the plasticized RDX carried home on work boots and clothing worn home.
Pasanen et al. [1989] Finland	Fungi	Farming	Air sampling with impactor; cultivation; SEM.	In farm homes: 10^3 to 10^4 colony forming units/m^3; total spores at 10^4 to 10^5 spores/m^3 were 10-1,000 times levels in urban homes. Certain fungal genera were measured in cow barns and farmers homes but not in control homes.	Study suggests that fungal spores were carried on clothes from cow barns to farmers' homes.

Table 15. (Continued) Workers' Home Contamination-Industrial Hygiene Aspects

Author [year] Location	Contaminant Basis for Study	Process	Industrial Hygiene Methodology	Industrial Hygiene Observation	Comments or Recommendations
Garrettson [1984]	Environmental toxicity	Pesticides, lead and other toxins	Literature review		Workers need to be informed about toxicity of compounds and the potential dangers of taking them home in one way or another. Lead regulations intended to protect workers' families need to be enforced.
Cannell et al. [1987a, 1987b]	Measurement of home contamination	Research: Shoe types, floor types, and traffic	Tracers: Polydisperse stilbene for carpets; mondisperse silicia particles for tile.	Ground contact with shoes is dominant factor in transport capacity; carpet removes soil from shoes more rapidly than tile; at most 50% of contaminant in carpet can be removed by intense vacuuming.	
Beegle and Forslund [1990]	Asbestos and lead	Not applicable	Protocols for cleaning homes contaminated with asbestos and lead are provided.	Not applicable.	
Goldman and Peters [1981]		Occupational and environmental health history.		Recommends that clinical physicians include occupation of family members to identify potential sources of exposure, including chemicals brought into the home from contaminated work clothes.	Article provides sequence of steps to facilitate physician recognition of occupationally and environmentally related diseases.
Fish et al. [1967]	Particulate	Experimental re-dispersion of settled particulates.	Light-scattering particle size analyzer.	Re-dispersion of settled particulates was dependent upon room activity. With light air movement, transfer from floor to clothing was 22%/hr.	Demonstrated potential for body and clothing contamination from resuspension of settled dust on workroom surfaces.
Schneider et al. [1989]	Non-specific dust.	Research	Surface sampling method using sticky gelatin foil.		Practical applications include assessment of the effectiveness of cleaning programs and characterization of surface contamination patterns.