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James P. Bulman

# ANALYSIS OF FIBER RELEASE FROM CERTAIN ASBESTOS PRODUCTS

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Prepared by

Peter H. Anderson
Marc A. Grant
Robert G. McInnes
William J. Farino

GCA CORPORATION
GCA/TECHNOLOGY DIVISION
Bedford, Massachusetts

# SECTION 6

# GASKETS AND PACKINGS

## INTRODUCTION

Gaskets and packings are found in virtually every mechanical, chemical, and thermal piece of process equipment where fluids are involved.[1] Gaskets and packings are primarily used to prevent leakage between two bearing surfaces: gaskets for static applications and packings for dynamic uses. Gaskets are needed to obtain tight nonleaking connections between pipe flanges and other joints such as the covers and openings on all types of industrial and commercial equipment. Packing is used as a dynamic seal for revolving or moving parts, preventing leakage of the contained fluid along the bearing surface.

Asbestos fibers have been used successfully in both product types because of their unique combination of qualities. In addition to providing heat resistance, resilience, and strength, the mineral fibers are also relatively chemically inert, which is an important factor for many of the gasket and packing applications.

### Gaskets

Asbestos-containing gaskets are made from either compressed sheet, beater-add paper, or millboard. Beater-add paper and millboard gaskets are discussed in Section 7 of this report under Paper Products. Gaskets made from compressed sheet are used in pumps, compressors, valves, pipe flanges, industrial and marine engines, gear and axle housings, sheet metal covers, shim gaskets, industrial transmissions, and transformers.[1-3] Because of the strength, chemical inertness, and heat resistance properties of asbestos fibers, the gasket material is used in applications where temperature, pressure, and fluid environments are extremely destructive. Compressed sheet has a higher density and lower polymer-content than beater-add paper and millboard, hence it is used in more severe environments.

The compressed sheet used to make gaskets is formed in a sheeting machine by rolling out a mixture of asbestos, binder, and solvent. The calendered sheet is then cut to size and packaged for shipment. Sheet manufacturing may be a wet or dry process depending on product requirements. Compressed sheet formulations vary with manufacturer and product grade. A commercial grade gasket sheet, used in applications up to 204°C (400°F), contains 75 to 80 percent asbestos, normally chrysotile, whereas specialty grade gasket sheet, used in higher temperature applications, may contain as much as 100 percent asbestos, including chrysotile and crocidolite fibers.[1,4]

Compressed sheet may be fabricated into gaskets at the primary manufacturing plant or more commonly sold to secondary processors or distributors who supply the industrial equipment maintenance market.

### Packings

Asbestos packing is a braided product manufactured from untreated asbestos yarn. The yarn is purchased from a primary manufacturer and made into the sealant material by a packing fabricator. The asbestos content in packing varies considerably, and may be as high as 100 percent for high temperature applications such as sealing furnace doors.[5] Braiding is performed using a flat belt common shaft electric driven machine or other similar equipment. The yarn used is untreated because resin impregnated or similarly coated yarn will not pass freely through the braiding machines.[6,7]

After the yarn has been braided, the newly formed packing material may be packaged as is, uncoated, or, more commonly, saturated with a lubricant. Dry, unlubricated asbestos packings are used to seal furnace doors, rotary kilns, and high-temperature refractory equipment.[5] Lubricated asbestos packings are employed in a variety of industrial, commercial, and residential equipment applications, as well as in motor vehicles. Saturation of the braided material is accomplished by passing the packing through a heated liquid bath that contains the lubricant. Some of the more common lubricants used in packing manufacture are:[5,7]

- petroleum based oils and waxes,
- high grade animal fats and waxes,
- Teflon,
- mineral oil,
- natural rubber,
- Buna-S rubber,
- vegetable oil,
- glycerine,
- graphite, and
- molybdenum disulfide.

This treatment process is performed to maintain product pliability while in service, to retard material desiccation, and to prevent the abrasive asbestos fibers from scoring machinery shafts and valve stems during use.[7,8] Final processing before packaging for sale, involves calendering the packing material into specific sizes and cross-sectional shapes.[1,7] Common cross-sectional shapes are round and square. Square packings are preferred because they provide a good seal, creating no gaps along the packing/shaft or valve stem interface.[8]

## SECONDARY PROCESSING--FABRICATION

### Gaskets

Secondary processing, which involves transforming the compressed sheet into a useable gasket product, is performed by an independent fabricator or the maintenance user. Fabricators, such as gasket cutters, generally form

gaskets from compressed sheets by die-cutting, while the maintenance user cuts the sheet manually (see End Use Activities subsection below). Independent fabricators, who cut the sheet to customer specifications, also supply uncut sheets to the maintenance user who will field fabricate the material to their own specifications. One secondary processor contacted, B and D Supply, Inc. of Yeadon, PA,[9] estimated that marketing uncut gasket sheet accounted for less than 10 percent of their annual sheet sales.

Gasket cutting by the secondary processor is normally performed by forcing a metal die through the compressed sheet using automatic or semiautomatic pressing machinery, which sometimes requires manual gasket sheet feeding.[9-11] The actual cutting process, when the die is forced through the gasket sheet, lasts only about 1 second, compared to up to a minute for product handling time. Because of the clean edge cut made and that asbestos fibers are firmly bound by the gasket matrix, the potential for fiber release during secondary processing is low. This explains, in part, why engineering dust control devices are not normally employed for the cutting operation and the press equipment is open to the workroom environment.[12,13] Operators may wear gloves during material handling, which includes sheet feeding, product separation (hand-picking), and packaging.[9]

Packings

Packing distributors[14-16] report that, in contrast to gaskets, packing is infrequently cut before being supplied to the end user. This is due to the simplicity of the packing/cutting procedure, as well as to the variations of end use application. A representative of Janos Industrial Insulation Corporation of Moonachie, NJ[15] did indicate, however, that packings may be cut to length by a secondary processor for a specific type of application using automatic machinery equipped with a wet dust suppression system.

Also, some distributors may mold packing, which does not involve material abrasion or severing, to a customer's specifications using an automatic press.[14-16] For most applications, however, direct distribution of the standard square or round cross-section material is sufficient to perform job requirements.

END USE ACTIVITIES

Gaskets

Compressed sheet gasket end use activities include installation, in-service use, and removal during equipment maintenance or gasket replacement. Gasket installation normally involves temporarily securing (holding) the precut material to one bearing surface while carefully aligning the other surface over the gasket. When the gasket is in place between the two rigid surfaces, the joint is sealed by torquing down bolts or clamps at regular intervals along the perimeter of the joint. In service, the gasket faces are isolated from fluids on either side of the joint by the pressure of the bearing surfaces. Gasket edges, however, may be exposed on the internal or external side of the joint. For special applications, field fabrication may be required to obtain the correct gasket size and shape. Gasket shaping can be performed with a sharp knife or scissors.[9]

After installation, the gasket's service life depends on the severity of work conditions and the frequency of equipment maintenance. A common cause for gasket replacement results from disassembly of the joint for routine maintenance. The gasket may be damaged during disassembly or its sealing capability may be in doubt due to low compression. Rather than risk a leak by reinstallation of the used gasket, a new one will be installed in most cases.[9,12] In 1978 it was estimated[4] that 15 percent of the asbestos-containing gasket materials* produced are used in new installations, 25 percent for replacement of gaskets failed within 1 year, and 60 percent for maintenance and long-time replacement.

During removal, portions of a gasket may adhere to the bearing surfaces if high temperatures or penetration of working fluids alters the elastomeric binder in the gasket matrix. The adhering material is typically removed manually using a flat-edged scraping tool (e.g., putty knife, paint scraper, or screwdriver) or a stiff wire brush.[10] In many cases the energy input must be well controlled to avoid damaging the joint surfaces, which must be smooth and level for a proper fit. The removal process lasts several minutes, whereas the overall maintenance task typically requires a half-hour or more. Penetration of the working fluid into the gasket material is expected to suppress fiber release during removal. To facilitate gasket release from bearing surfaces, some compressed sheet manufacturers offer materials covered with an anti-stick film.[17-19]

Packings

Similar to gaskets, the end use activities associated with packing applications include installation, in-service use, and removal. Packing installation varies depending on whether the process equipment to be serviced requires a dynamic or static seal. Pump and agitator shafts, hydraulic cylinders, and valve stems require a dynamic seal and are packed in a somewhat similar manner. These devices have a shaft that is in contact with process fluids in the interior of the pump, valve, or vessel. Where the shaft exits the device it must be sealed to prevent or control leakage of process fluids. The shaft exits these devices through a cylindrical cavity commonly referred to as a "stuffing box."[8] The annular space between the shaft and stuffing box is filled with packing material to control leakage. The packing is sized to fill this cavity by forming it into rings. Rings are formed by wrapping the packing around the shaft and cutting with a knife.[8,20,21] Packing rings may be coated with oil or grease before pushing them along the shaft and into the stuffing box. Most applications require from 4 to 10 rings seated back-to-back in the stuffing box.[20,21] When in place, the packings bear against the inner (static) surface of the stuffing box and the outer (dynamic) surface of the shaft. Packings are held in place in the stuffing box by the "gland," a metal cylinder with a lip that is tightened against the stuffing box. In a pump or agitator, the gland is tightened (pressing against the

*Meylan's estimate includes compressed sheet, beater-add paper, and millboard gaskets. The latter two are addressed in Section 7.

packing material in the stuffing box) only enough to control leakage of process fluid between the packing and the rotating shaft. Some leakage is required to provide lubrication to the packing.[20,21]

Packings used in static applications to seal process equipment doors or covers typically include twisted, braided, and plaited ropes as well as square or rectangular composites.[21,22] These materials are held in place by pressing them into a performed, milled groove or recess in the door or cover plate. The packing is usually cut to length using a sharp knife. In a door or cover static application, the packing functions in a manner similar to a gasket in that adjoining surfaces are stationary. Door and cover packings are usually unlubricated, although a rubber cement or elastomer may be used to help hold the material in place during installation.[21]

In service, dynamic packings may fail for a number of reasons. Failures are frequently related to improper size selection (thickness or cross-sectional shape) or installation (cut length), worn or misaligned shaft or stuffing box, insufficient lubrication, or improper gland tightening. Packing failure may also result from loss of flexibility, chemical attack, or lubricant boil-off.[20,21] The service life of dynamic packing material has been estimated to be less than 1 year for 90 percent of the packing applications, while the rest wear out much more rapidly.[4]

Failure of process equipment door or cover packings is usually related to alignment or compaction, since there is little wear on the material surface (no movement) and these materials contain a high percentage of asbestos, capable of withstanding temperature and chemical extremes. When properly installed, the service life of static packings generally depends on two factors: (1) material reaction with the fluid or gases being contained by the packing, and (2) frequency of process equipment maintenance.[1,7] Chemical reactions with process fluids or gases may degrade the packing material causing failure of the seal and leakage. Maintenance, whether scheduled or nonscheduled, prematurely shortens the service life of the packing by requiring replacement of the material that has been damaged when the seal is broken.[1,7]

Removal of worn out packing from a pump, valve, or hydraulic piston requires equipment disassembly, followed by removal of the 'gland' (when present) and extraction of the material from the stuffing box using screw-tipped or pointed rods.[8,20,21] Depending on how well lodged they are in the stuffing box, the packing rings may be torn during removal.[8] Removal of a static packing from a door or cover is somewhat easier because of better access. Under these conditions the material is easily peeled off the door or cover plate or pried out of a retaining groove with a sharp object.

The removal and subsequent installation of dynamic or static packing material may last from one-half hour to more than an hour depending on the size of the equipment and ease of access.[8] The majority of the time spent during servicing is in disassembly and reassembly of the equipment. Material cutting will last only a few seconds and actual packing installation and removal will each require only a few minutes.[8] Packing installation and removal operations are performed indoors or outdoors, wherever the equipment being serviced is located.

Fiber release from the handling and use of lubricated packings is expected to be very low. Packings, used in pumps, valves, and pistons, are impregnated or coated with a lubricant that suppresses dusting. Cutting operations performed during installation should cause minor or no dusting. Cuts must produce a clean, smooth edge in order to ensure good end closure when the packing is in place. In service and during removal asbestos fiber release is also expected to be low due to material saturation.

Concerning fiber releasability from unlubricated packings used in static applications, Johns-Manville reports[23] that where a door or cover is periodically opened or closed, the packing is decompressed and compressed, but without much abrasion. The potential for fiber release to the atmosphere is expected to be highest during removal of the unlubricated packing. The door/cover packings are generally twisted or woven to promote easy release from the sealing surface during use,[21] but prolonged compaction in a retaining groove, for example, may necessitate scraping when replacement is required. The packing material will be physically altered during this process, possibly releasing asbestos fibers.

AIRBORNE FIBER MONITORING DATA

Gaskets

Secondary Processing - Fabrication--

Airborne fiber monitoring data collected during the fabrication of compressed sheet into gaskets are presented in Table 16. Fiber concentrations for the processes monitored, which included machine cutting, hand shaping, and various materials handling operations, ranged from less than 0.01 to 1.3 $f/cm^3$, with the exception of hand and machine punching operations that were performed without dust controls. Fiber concentrations measured for the uncontrolled hand and machine punching operations were 3.0 and 5.0 $f/cm^3$, respectively. When control measures were applied to these two operations, fiber concentrations of less than or equal to 0.15 $f/cm^3$ were recorded.

End Use Activities--

Fiber monitoring data collected during the installation and removal of compressed sheet gaskets are also presented in Table 16. Fiber concentrations measured during the performance of these end use activities were less than 0.4 $f/cm^3$. The highest concentration recorded (0.39 $f/cm^3$) occurred during gasket removal, which involved cleaning (hand scraping) adhering residue from a bearing surface. Airborne asbestos fiber release is not expected during gasket wear because the bearing surfaces are stationary during use.

Packings

Secondary Processing - Fabrication--

Because there is virtually no secondary processing of packings, no airborne fiber monitoring data were obtained.

End Use Activities--

In April 1979, Johns-Manville conducted an airborne fiber monitoring study of routine packing installation, in-service use, and removal activities at their Manville, NJ plant.[23] The simulated field operations were

TABLE 16. FIBER CONCENTRATIONS ASSOCIATED WITH VARIOUS COMPRESSED ASBESTOS SHEET GASKET HANDLING ACTIVITIES[10,11,24]

| Study | Activity performed | Measured fiber concentrations ($f/cm^3$) | Date of tests | Duration of activity/ sample time (min) | Analytical method | Comments |
|---|---|---|---|---|---|---|
| A | Punch press operation | 0.04 to 0.67 | 1980 | 80 to 211 | Fibers were counted by PCM[a] with PLM[b] verification | Monitoring performed at a major gasket fabricator located in Wisconsin |
| | Power shear operation | 0.17 | 1980 | 188 | Fibers were counted by PCM with PLM verification | Monitoring performed at a major gasket fabricator located in Wisconsin |
| | Shear press operation | 0.23 to 0.81 | 1980 | 50 to 76 | Fibers were counted by PCM with PLM verification | Monitoring performed at a major gasket fabricator located in Wisconsin |
| | Roussel press | 0.04 to 0.08 | 1980 | 100 to 192 | Fibers were counted by PCM with PLM verification | Monitoring performed at a major gasket fabricator located in Wisconsin |
| | Picking operation | 0.10 to 0.31 | 1980 | 93 to 206 | Fibers were counted by PCM with PLM verification | Monitoring performed at a major gasket fabricator located in Wisconsin |
| | Tumbling operation | 0.42 to 0.60 | 1980 | 77 to 141 | Fibers were counted by PCM with PLM verification | Monitoring performed at a major gasket fabricator located in Wisconsin |
| | Materials handling | 0.11 to 0.34 | 1980 | 91 to 216 | Fibers were counted by PCM with PLM verification | Monitoring performed at a major gasket fabricator located in Wisconsin |
| | Platen press operation | 0.05 to 0.29 | 1980 | 52 to 256 | Fibers were counted by PCM with PLM verification | Monitoring performed at a major gasket fabricator located in Wisconsin |
| B | Platen press operation | 0.03 to 0.15 | 1980 | 63 to 238 | PCM | Monitoring performed at an asbestos-using gasket operation in Wisconsin |

(continued)

TABLE 16 (continued)

| Study | Activity performed | Measured fiber concentrations ($f/cm^3$) | Date of tests | Duration of activity/ sample time (min) | Analytical method | Comments |
|---|---|---|---|---|---|---|
| | Hydraulic beam press | 0.02 to 0.05 | 1980 | 61 to 178 | PCM | Monitoring performed at an asbestos-using gasket operation in Wisconsin |
| | Hand picking and packaging | 0.06 to 0.20 | 1980 | 45 to 176 | PCM | Monitoring performed at an asbestos-using gasket operation in Wisconsin |
| | Platen press picking operator | 0.09 to 0.12 | 1980 | 67 to 140 | PCM | Monitoring performed at an asbestos-using gasket operation in Wisconsin |
| | Reeves punch press operator | 0.12 | 1980 | 124 | PCM | Monitoring performed at an asbestos-using gasket operation in Wisconsin |
| C | Storage for receipt and issue | < 0.01 to 0.05 | 1978 | 60 to 132 | PCM | Housekeeping[c] performed, monitoring conducted under actual work conditions |
| | Storage for use | < 0.01 to 0.12 | 1978 | 97 to 122 | PCM | No control,[d] monitoring conducted under actual work conditions |
| | Hand punching | 3.00 | 1978 | NR | PCM | No control, monitoring conducted under actual work conditions |
| | Hand punching | < 0.05 to 0.15 | 1978 | 28 to 31 | PCM | Housekeeping performed,[b] monitoring conducted under actual work conditions |
| | Hand operated mechanical punching | < 0.05 | 1978 | 30 | PCM | No control, monitoring conducted under actual work conditions |

(continued)

TABLE 16 (continued)

| Study | Activity performed | Measured fiber concentrations ($f/cm^3$) | Date of tests | Duration of activity/ sample time (min) | Analytical method | Comments |
|---|---|---|---|---|---|---|
| | Machine punching | 5.0 | 1978 | NR | PCM | No control, monitoring conducted under actual work conditions |
| | Machine punching | < 0.03 to 0.7 | 1978 | 20 to 30 | PCM | Housekeeping performed, monitoring conducted under actual work conditions |
| | Machine punching | < 0.05 to 0.06 | 1978 | 23 to 31 | PCM | Housekeeping and ventilation,[e] monitoring conducted under actual work conditions |
| | Hand shaping | < 0.03 to 0.3 | 1978 | 7 to 31 | PCM | No control, monitoring conducted under actual work conditions |
| | Machine shearing | 0.5 to 1.3 | 1978 | 6 | PCM | No control, monitoring conducted under actual work conditions |
| | Machine shearing | 0.05 to 0.15 | 1978 | 31 to 38 | PCM | Housekeeping performed, monitoring conducted under actual work conditions |
| | Machine nibbling | < 0.08 to 0.46 | 1978 | 8 | PCM | No control, monitoring conducted under actual work conditions |
| | Machine nibbling | 0.08 to 0.8 | 1978 | 24 to 31 | PCM | Housekeeping performed, monitoring conducted under actual work conditions |
| | Installation of flange gasket | < 0.03 | 1978 | 30 | PCM | No control, monitoring conducted under actual work conditions |

(continued)

TABLE 16 (continued)

| Study | Activity performed | Measured fiber concentrations ($f/cm^3$) | Date of tests | Duration of activity/ sample time (min) | Analytical method | Comments |
|---|---|---|---|---|---|---|
| | Removal and concurrent installation (boiler header gaskets) | 0.02 to 0.3 | 1978 | 21 to 95 | PCM | Housekeeping performed, monitoring conducted under actual work conditions |
| | Clean-up following removal by hand scraping | < 0.05 | 1978 | 33 to 37 | PCM | No control, monitoring conducted under actual work conditions |
| | Removal and hand scraping | < 0.06 to 0.39 | 1978 | 15 to 28 | PCM | No control, monitoring conducted under actual work conditions |
| | Removal and wire brushing | < 0.03 to 0.18 | 1978 | 25 to 33 | PCM | Housekeeping performed, monitoring conducted under actual work conditions |

[a]Phase contrast microscopy.

[b]Polarized light microscopy, thus reported fiber concentrations are all assumed to asbestos fibers.

[c]Housekeeping - high efficiency vacuum cleaners were used to clean areas (area kept clean and free of debris accumulation), waste material placed in sealed containers.

[d]No control - no specific controls were used; i.e., no wetting, enclosing, or ventilation.

[e]Ventilation - filtered local exhaust ventilation provided to operation.

NR - Not Reported



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performed on two water circulating side-by-side pumps. An area air sample between the pumps and a simultaneously collected personal sample were obtained. Both ends of each pump was packed with five rings of material, therefore 20 sections of packing were used per test. Six different dynamic packings were tested over a 4-day period. The duration of each test period was not reported. A minimum of four separate samples were taken for each packing tested: two (one area, one personal) during installation and use, and two during removal. The installation and removal operations performed were similar to those described above in the End Use Activities subsection.

Four of the packings tested were impregnated with petroleum-based lubricants, one was impregnated with a corrosion inhibitor and treated with a graphite surface finish, and one was rubber-coated and treated with graphite. No unlubricated or uncoated packings (e.g., used in static door/cover applications) were tested.

Of the 28 samples collected, 5 had a fiber concentration* of 0.0 f/cm$^3$, 10 had a concentration of "less than 0.1" f/cm$^3$, 12 had a concentration of 0.1 f/cm$^3$ and one sample, an area sample taken during the removal of the rubber-coated packing, had a measured concentration of 0.2 f/cm$^3$. In general, the personal samples revealed slightly higher fiber concentrations than the area samples, and the installation/use activity samples showed slightly higher concentrations than the removal activity samples.

SUMMARY OF FINDINGS

Gaskets

Secondary processing of compressed sheet into gaskets can result in comparatively high workroom fiber concentrations, on the order of 3.0 to 5.0 f/cm$^3$ during hand and machine punching, if control measures are not employed. When dust control procedures are implemented, which is usually the case, fiber concentrations resulting from various hand and machine processing steps and materials handling operations range from less than 0.01 to 1.3 f/cm$^3$.

Measured airborne fiber concentrations resulting from the installation of compressed sheet gaskets were less than 0.03 f/cm$^3$ as reported by one study. Removal of these materials, however, can result in higher concentrations, up to 0.4 f/cm$^3$ during hand scraping of worn material adhering to a bearing surface. In this latter case, fiber release is related to the physical exertion required to remove the material and to the high asbestos content (equal to or greater than 75 percent) of compressed sheet gasket. Table 17 summarizes the data presented in this section on compressed sheet gaskets and identifies the principal activities of concern with respect to asbestos fiber release.

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*Phase contrast microscopy analysis assumed.

TABLE 17. SUMMARY OF COMPRESSED SHEET GASKET SECONDARY PROCESSING AND END USE ACTIVITIES

| Product: Gaskets | Secondary processing | End use |
|---|---|---|
| Activity: | Die-cutting, packaging | Installation; in-service use; removal |
| Duration: | | |
| Per Incident | Cutting: less than 1 second<br>Packaging: up to 1 minute | Installation; 1-2 minutes<br>Use: weeks to years, depending on application<br>Removal: 5 to 20 minutes, equipment disassembly will require several minutes to more than an hour |
| Daily total | Cutting: several minutes.<br>Packaging: total production time over 8 hour work shift | Same as above |
| Fiber Releasability: | Moderate | Moderate |
| Chemical Composition | Asbestos fiber content 75 to 80% in commercial grades, up to 100% for high temperature applications | Same |
| Physical Composition | Pliable, may have anti-stick coating, usually "oily" surface texture | Same |
| Disruptive Energy | Hydraulic press die-cutting; sorting and packaging by hand | Removal; hand scraping, hand or power tool brushing to clean bearing surface |
| Control Measure(s): | Other than general housekeeping involving vacuuming the process areas, no engineering controls are used. | Generally none, though during removal operation gasket may be saturated with process fluids. Further wetting of worn material prior to removal may also be performed. |
| Measured Fiber Concentrations ($f/cm^3$): | 0.1 to 1.3 with general housekeeping<br>0.1 to 5.0 without controls | 0.02 to 0.4 during installation, in-service use and removal |
| Environmental Setting: | Open room, indoors | Open room, indoors or outside |

Activities of Concern

Secondary fabrication, especially die-cutting gaskets. End use, removal of worn gaskets, particularly the cleaning of adhering material from bearing surfaces.

Packings

Secondary processing of asbestos-containing packings is generally limited to molding operations, in which the material is pressed without material abrasion or severing. Any cutting of the packing is routinely performed by the end user during installation, using hand tools. Installation of dynamic packings results in fiber releases on the order of 0.1 f/cm$^3$. Dynamic packings are prelubricated and/or coated with friction reducers before use and further lubricated by process fluids during use. When dynamic packing material removal is required, the material is usually saturated with process fluid or still contains residual amounts of lubricant, both of which act to suppress fiber release. Removal is performed using hand tools requiring low energy inputs. Some material disintegration can be expected during the removal of severely worn packing. Airborne fiber concentrations equal to or less than 0.2 f/cm$^3$ have been recorded during the removal of packing from a mechanical pump.

Fiber monitoring studies documenting asbestos fiber release from unlubricated packings used for static applications have not been reported in the literature. Asbestos fiber release is expected from these types of packings during cutting, installation, and removal because they contain a high asbestos content, have a low binder content, and are not normally treated or coated with any type of lubricant that would suppress fiber release. Table 18 summarizes the data presented on packings and identifies the principal activity of concern with respect to asbestos fiber release.

TABLE 18. SUMMARY OF PACKING SECONDARY PROCESSING AND END USE ACTIVITIES

| Product: Packings | Secondary processing | End use |
|---|---|---|
| Activity: | Rarely performed, but may be cut to length or molded | Installation (including cutting); in-service use; removal |
| Duration: | | |
| Per Incident | Cutting: less than 1 second actual cutting. Molding: several minutes (est.) | Installation: 10-30 minutes (Cutting: up to 1 minute actual). Use: weeks to years, depending on application Removal: 10 to 30 minutes |
| Daily total | Cutting: several min. actual cutting Molding: totalling more than 1 hour (est.) | Same as above |
| Fiber Releasability: | Moderate | Low |
| Chemical Composition | Fiber content up to 100% (rare); wide variation in type and amount of lubricant/ coating, depending on intended use. | Same; but dynamic packing may be coated with lubricant during installation, and may be saturated with process fluid during removal. Static packings will be unlubricated. |
| Physical Composition | Flexible, oily or waxy surface when lubricated | Same |
| Disruptive Energy | Cutting with a knife or press machine, molding in press machines | Knife or shears for cutting during installation; pointed or screw-tip extractor to remove dynamic packing from stuffing box. Flat-bladed knives to remove static packings. |
| Control Measure(s): | Wet suppression dust control during automated cutting. No control during molding | None |
| Measured Fiber Concentrations ($f/cm^3$): | No data reported, work-room concentration assumed to be less than 2 $f/cm^3$ | 0.0 to 0.2 during the installation, in-service use and removal of lubricated and/or coated dynamic packings. No data reported for unlubricated packings. |
| Environmental Setting: | Open room, indoors | Open room indoors or outdoors |

Activity of Concern

Removal of worn packings, especially unlubricated materials used in static applications.

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