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"ASBESTOS GASKETS: EXPOSURES AND SUBSTITUTES", R. T. CHENG, H. J. McDERMOTT, T. V. SMITH, AND E. H. NICCOLLS, CHEVRON CORPORATION, P. O. BOX 7924, SAN FRANCISCO, CA. 94120

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INTRODUCTION

Asbestos gaskets are used extensively in piping (flanges), valves, pumps, and other equipment to prevent leakage of fluids between solid surfaces. Its high physical strength, heat and chemical resistance and low cost make asbestos a good choice where these features are needed. In July, 1989, the U. S. Environmental Protection Agency (EPA) ruled to prohibit the manufacture, importation, processing, and commercial distribution of essentially all asbestos gaskets by August, 1994. EPA's decision to ban asbestos gaskets was based on exposure data at the asbestos gasket manufacturing facilities. EPA lacked data to characterize gasket user's exposures.

Despite the EPA's recent action, asbestos gaskets will be handled for many years in the workplaces as in-service gaskets are replaced and inventories of the remaining asbestos gasket material are used. This paper presents data on asbestos exposures during use and handling of asbestos gaskets in the oil and chemical industries. Also presented are acceptable brands of non-asbestos gaskets.

TYPES OF ASBESTOS GASKETS

The three types of gaskets commonly used in the oil and chemical process plants are sheet gaskets, spiral wound gaskets and metal jacketed gaskets. Metal jacketed gaskets are primarily used in large heat exchangers or vessel manways. Because the asbestos filler material in a metal jacketed gasket is virtually enclosed by the metal jacket, asbestos exposure is not a problem for metal jacketed gaskets. Therefore, the emphasis of this paper is on spiral wound gaskets and sheet gaskets.

ASBESTOS EXPOSURES

SPIRAL WOUND GASKETS:

Spiral wound gaskets come pre-fabricated from the manufacturers. Therefore, there are no asbestos exposures related to the on-site gasket fabrication or alteration. The asbestos filler material in a spiral wound gasket is held tightly by stainless steel windings and by a carbon steel outer compression ring. During gasket replacing, an after-service spiral wound gasket can be easily lifted from the seating surfaces. In fact, for a vertically installed spiral wound gasket, the old gasket would fall off by its own weight as soon as the seating surfaces are separated (Figure 1).

Before installing the new gaskets, workers may wipe the seating surfaces clean with a rag, or may remove any corrosion with a wire brush (Figure 2). Any asbestos fibers remaining on the seating surfaces are thus disturbed, resulting in a brief increase in airborne asbestos concentration.

A 30 minute air sample was collected during a task to replace two spiral wound gaskets in a piping system. The monitoring period covered the lifting and disposal of the old gaskets, wire brushing the surfaces of the flanges, and installation of the new gaskets. Results show non-detectable airborne fiber levels (less than 0.06 fibers/cc), indicating no worker exposure problem during the use and handling of spiral wound gaskets.

FABRICATION OF SHEET GASKETS:

At Chevron's refineries and larger chemical plants, asbestos sheet gasket materials are usually purchased in bulk sheets. These are later fabricated into gaskets of various sizes and shapes at the facility's machine shop. Special equipment and tools are used in the fabrication process (Figure 3). Monitoring results of workers' exposure during gasket fabrication are shown in Table A (TWA) and B (Short Term). The exposures levels are below the OSHA Permissible Exposure Limit and Excursion Limit.

REPLACING SHEET GASKETS:

The sheet gaskets are under tremendous seating stress (say 10,000 psi) during service; and they may be in contact with oxidizing or corrosive fluids. As the sealing surfaces are separated, sometimes the after-service sheet gasket tears, and pieces of the broken gasket material stick tightly to one or both of the seating surfaces. A flat screw driver or a scraper is used to lift the broken gasket off the metal (Figure 4), followed by brushing or sanding to clean the seating surfaces before installing the new gasket (Figure 5).

Table C summarizes results of exposures during replacement of after-service sheet gaskets. One of the three short-term personal air samples shows 1.4 fibers/cc. Although that particular air sample was collected in 1986 and was in compliance with the then applicable OSHA PEL of 0.2 fibers/cc (as 8-hour TWA), it no longer meets the currently applicable 1.0 fiber/cc OSHA Excursion Limit.

A wet work method was later established at Chevron facilities for the removal of after-service sheet gaskets. Typically, the wet work procedure calls for the spraying of a solvent or a wetting agent (e.g., Chesterton 723 Sprasolvo Penetrating Oil) to wet the gasket and the seating surfaces (Figure 6) before removing the gasket and cleaning the seating surfaces. In addition, workers are required to wear a HEPA respirator when brushing or sanding, or when handling asbestos waste materials. Monitoring results for wet removal of sheet gaskets are shown in Table D. Workers' short-term asbestos exposures were well within the OSHA Excursion Limit.

GASKET TRAILER WORKER EXPOSURE:

At Chevron's larger refineries, gaskets of all types are kept in a special storage facility called the Gasket Trailer. The trailer is staffed by an attendant whose duties are to maintain an inventory of gaskets, to collect and dispose of used gaskets, and to distribute new gaskets to other workers. During unit shutdown and turnaround time, the attendant can be extra busy as gaskets in many pieces of equipment are replaced. Six personal air samples were collected from Gasket Trailer attendants during two major unit shutdowns in an oil refinery. Results show workers' 8-hr time-weighted average exposures ranged from 0.037 to 0.058 fibers/cc, well within the OSHA PEL of 0.2 fibers/cc.

NON-ASBESTOS GASKETS

Asbestos gasketing materials play an important role where their special features are needed. Their use remains acceptable as long as they are still commercially available. Although many major manufacturers (Garlock, Klinger, Chesterton, Durabla, and Asberit) continue to produce asbestos gasketing materials, some local distributors have refused to supply asbestos gaskets to avoid liability. Manufacturers and distributors of gasketing materials will soon standardize on non-asbestos products.

For these reasons, an evaluation of gasket tests and operating experience throughout the oil and chemical industries was conducted by the Materials Division of the Chevron Research and Technology Company. The end result is a report on Non-Asbestos Gaskets, and a Corporate Drawing GD-L1264-0, "Gasket Specifications and Acceptable Brands". Table E shows a simplified version of Chevron's recommendations for non-asbestos sheet gaskets, while Table F shows a simplified version of Chevron's recommendations for non-asbestos spiral wound gaskets.

CONCLUSIONS

Workers' TWA exposures to asbestos during on-site fabrication, handling and replacement of gaskets were all within the OSHA PEL. However, the practice of dry removal of after-service sheet gaskets, followed by dry polishing of the seating surfaces with a sander, can create a short-term exposure in excess of the OSHA Excursion Limit. After-service sheet gaskets should be removed in wet conditions to avoid fiber release, and respiratory protection should be provided as a precautionary measure.

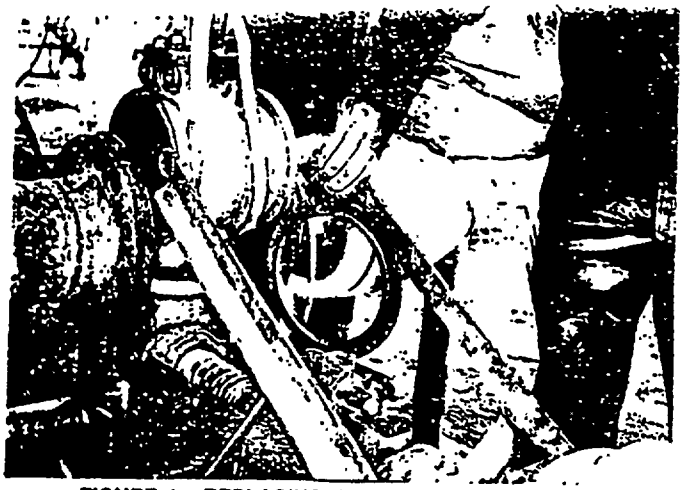


FIGURE 1 - REPLACING A SPIRAL WOUND GASKET



FIGURE 2 - BRUSHING GASKET SEATING SURFACES

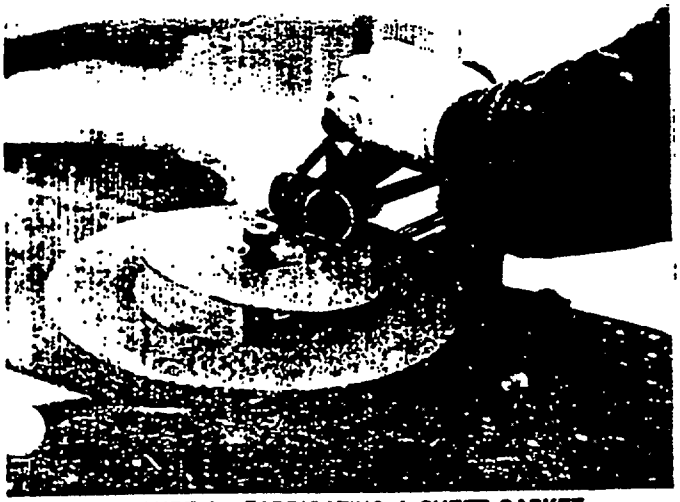


FIGURE 3 - FABRICATING A SHEET GASKET



FIGURE 4 - REMOVING A BROKEN SHEET GASKET



FIGURE 5 - BRUSHING THE GASKET SEATING SURFACES

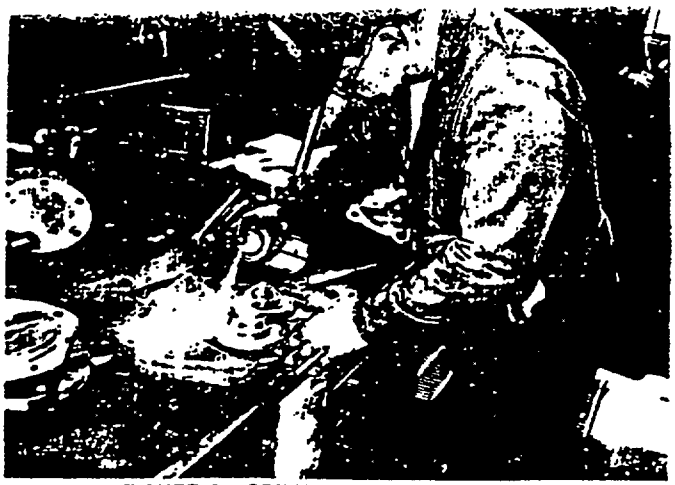


FIGURE 6 - SPRAYING A WETTING AGENT

TABLE A

WORKERS' TWA ASBESTOS EXPOSURES DURING FABRICATION OF ASBESTOS SHEET GASKETS

TASK DESCRIPTION	SAMPLING DURATION	CONC., FIBERS/CC
Cutting gaskets with power shear & hammer punch (3 Samples)	330 min	0.015
	344 min	0.009
	359 min	0.005
Cutting gaskets with power shear & wheel cutter	408 min	0.017
Cutting gasket with knife on a lead-surface table	490 min	0.012

OSHA Permissible Exposure Limit: 0.2

TABLE B

WORKERS' SHORT-DURATION ASBESTOS EXPOSURES DURING FABRICATION OF ASBESTOS SHEET GASKETS

TASK DESCRIPTION	SAMPLING DURATION	CONC., FIBERS/CC
Cutting sheet gaskets with a saber saw (2 Samples)	55 min	0.39
	55 min	0.33
Cutting gaskets with power shear & wheel cutter (2 Samples)	30 min	0.49
	30 min	0.34

OSHA Short-Term Excursion Limit: 1.0

TABLE C

WORKERS' SHORT-DURATION ASBESTOS EXPOSURES, DRY METHOD TO REPLACE AFTER-SERVICE SHEET GASKETS

TASK DESCRIPTION	SAMPLING DURATION	CONC., FIBERS/CC
Replacing pump & valve gaskets, dry scraping/brushing to clean metal surfaces (2 Samples)	19 min	0.11
	46 min	0.19
Replacing two sheet gaskets, dry brushed to clean flanges	55 min	0.33
Replacing a sheet gasket, used a power sander to dry polish the pipe flange.	25 min	1.4

OSHA Short-Term Excursion Limit: 1.0

TABLE D

WORKERS' SHORT-DURATION ASBESTOS EXPOSURES, WET METHOD TO REPLACE AFTER-SERVICE SHEET GASKETS

TASK DESCRIPTION	SAMPLING DURATION	CONC., FIBERS/CC
Replacing a pump gasket in shop, wetting agent used before removal & cleaning	30 min	<0.06
Replacing gaskets in the field, wetting agent used prior to removal & surface cleaning	15 min	<0.03

OSHA Short-Term Excursion Limit: 1.0

TABLE E

NON-ASBESTOS SHEET GASKET RECOMMENDATIONS

AIR AND WATER SERVICES BELOW 300°F:
ARAMID FIBER (KEVLAR) REINFORCED, NITRILE OR NEOPRENE BOUND, E.G., CHESTERTON 195, LAMONS 3000, SEPCO 6234, JOHN CRANE 2160.

ACID SERVICES:
BARIUM SULFATE FILLED PTFE (TEFLON) SHEET GASKETING, E.G., GARLOCK "GYLON 3510".

ALL OTHER SERVICES:
FLEXIBLE GRAPHITE WITH TYPE 316 SS FOIL CORE, E.G. FLEXITALLIC "FLEXICARB", UNION CARBIDE "GRAFOIL GHR", AND POLYCARBON "CALGRAPH BSSC".

TABLE F

NON-ASBESTOS SPIRAL WOUND GASKET RECOMMENDATIONS

ACID SERVICES:

PTFE (TEFLON) FILLED SPIRAL WOUND GASKETS WITH METAL WINDINGS WHICH ARE RESISTANT TO CORROSION FROM THE SPECIFIC ACID TYPE, E.G., 304 SS FOR NITRIC ACID, 316 SS FOR PHOSPHORIC ACID, ALLOY 20 FOR SULFURIC ACID, AND MONEL FOR HYDROFLUORIC ACID.

ALL OTHER SERVICES:

FLEXIBLE GRAPHITE FILLED, WITH 304 SS WINDINGS, E.G., UNION CARBIDE "GRAFOIL", FLEXITALLIC "FLEXICARB" AND POLYCARBON "CALGRAPH".