SUMMARY

Compressed asbestos fibre (CAF) gaskets have been used successfully at the Kinleith mill of NZFP Pulp and Paper Limited since operations commenced. As part of a program to remove asbestos products from the site a substitute gasket material was chosen in 1985. Shortly after its introduction gasket failures were experienced in high temperature/pressure weak black liquor applications. For these applications the substitution program was suspended while a specific program to test gaskets for pulp mill use was developed.

Laboratory trials were then commissioned to evaluate substitute materials and compare them to CAF performance. CAF gaskets [illegible] performance to the substitute materials currently [illegible] [illegible] active. New substitutes [illegible] [illegible] only those with a performance equ[illegible] CAF gaskets progress to in-plant trial use.

Asbestos — Substitute Gaskets: Experience at Kinleith Pulp and Paper Mills

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Asbestos can cause a health hazard if inhaled in sufficient quantities. The last 20 years has seen increasing awareness of this hazard in industrialized countries; this has been recognized by stringent restrictions to the levels of exposure allowable and a move to use other products as substitutes.

At the Kinleith mill of NZFP Pulp and Paper Limited there has been an active program to reduce asbestos exposure by strictly controlling its use (*eg*, using a dedicated controlled atmosphere workshop for work on brake linings) and removing asbestos completely where satisfactory substitutes exist (*eg, removing asbestos-containing insulation*). The Kinleith Site Asbestos Safety Committee composed of management and workforce representatives was set up in the early 1980s to ensure a unified and coordinated approach on this work.

Gaskets

In 1985 attention was directed to compressed asbestos fibre (CAF) gaskets which were universally used across the site. While installed within flanges in the plant, there is no prospect of release of asbestos from such gaskets. However, during cutting and removal of CAF gaskets, tests at Kinleith showed that asbestos concentrations greater than the permitted threshold limit values may be generated.

In the late 1970s the use of asbestos packing materials following the successful application in the plant of substitute materials — informal mill trials had shown that the high technology teflon/kevlar based packings were suitable substitutes. Hence it was expected that a suitable gasket substitute would be found.

From 1981 similar informal mill trials of asbestos-substitute gasket materials had been made and by 1985 18 months trouble-free use of a kevlar-based gasket had been achieved in our 'worst use' pulp mill test location. Accordingly in December 1985, CAF gaskets ceased to be a general issue item and the kevlar-based sheet material was substituted along with increased stocking of spiral wound metal gaskets. The substitute chosen was regarded as being over specified for many duties (such as water, air lines) but by choosing a single product the possibility of incorrect application in critical use was removed.

Table 1
Air test results from cutting compressed asbestos fibre gaskets

Cutting method	Asbestos fibres released (% of TLV)*
Hand snips	500
Electric nibbler	270
Grinder	too high to measure
Scraping off old gasket	600
Punch	100

*Threshold limit values.

On air, water, oil and stock lines, the substitute sheet material has performed well. However, within the pulp mill, on weak black liquor lines a number of blow-out failures were experienced in circumstances indicating the material had definite pressure/temperature limitations. Accordingly, on such high pressure/temperature liquor applications, the use of CAF gaskets was reverted to while further investigations were undertaken.

The New Zealand research company, Process Developments Limited then surveyed the literature on gaskets and gasket testing methods on our behalf. During this time the company supplying the substitute gasket material were also very active and forthright in addressing the problem and providing technical information.

Most of the recently published information on gasket materials focuses on the relative 'leakage rate' of the assembled joints for which the permeability of the gasket is the major factor. A German research paper about work in chemical factories showed that substitute gaskets out-perform CAF gaskets in this property. No research or applications covering the use of substitute gasket materials within the pulp and paper industry was identified.

Examination of the failed substitute gaskets at Kinleith typically revealed that gasket material had become brittle and hard; surfaces exposed to black liquor were eaten away and creep around the bolt holes was evident. All of which explained the blow-out type nature of the failures experienced. Within the plant it has also been noted that should a minor gasket weep develop tightening the bolts was not successful and that such weeps progressed to blow-outs extremely quickly—the forgiving nature of CAF gaskets was not being duplicated.

GASKET TEST PROGRAM

In conjunction with Process Developments Limited, NZFP Pulp and Paper Limited developed a screening gasket testing program aimed at evaluating the gasket materials relative to CAF gaskets in hot weak black liquor solutions. Gasket suppliers in New Zealand were contacted and asked to participate in a gasket testing program commissioned by NZFP Pulp and Paper Limited and Tasman Pulp and Paper Limited in mid 1986. The testing program was controlled by Process Developments Lim-

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ited with the tests being made at the Hutt Valley laboratories of the Department of Scientific and Industrial Research.

Fourteen gaskets were tested: 2 asbestos (as control samples); 5 kevlar based substitutes; 5 graphite based substitutes; 1 PTFE based substitute; and 1 glass fibre based substitute. The test fluid was weak black liquor (12–20% concentration) from the Kinleith Kamyr continuous digester.

Gasket tests for use requirements

The gaskets were subjected to three series of tests:

Autoclave tests:

- Ten days exposure to weak liquor at 175°C and 2000 kPa.
- Visual assessments to check chemical compatibility.
- Fluid resistance assessment by mass and thickness measurements.

Strength tests:

- Tensile strength measurements to establish crushing, blow-out, durability factors.

Creep Relaxation:

- To assess the retained compressive stress for sealing.

Visual Assessment test results

- Only CAF gaskets unaffected by the weak black liquor autoclave treatment.
- Kevlar gaskets became soft and bowed.
- Graphite gaskets started delaminating.
- PTFE gasket showed little change.
- Glass fibre gasket swelled greatly, became soft and rubbery.

Gasket volume changes test results

Difference before and after autoclave treatment

- CAF gaskets showed a slight increase.
- Kevlar gaskets showed a significant increase (40 to 115%).
- Graphite gaskets essentially impervious.
- PTFE gasket essentially impervious.
- Glass fibre gasket swelled grossly (300%).

Creep relaxation test results

Most samples displayed an increased tendency to creep after autoclave treatment. Creep relaxations were:

- CAF gaskets exhibited 70 to 80%.
- Kevlar gaskets exhibited 85 to 100%.
- Graphite gaskets exhibited 40 to 70%.
- PTFE gasket exhibited 80%.
- Glass fibre gasket exhibited 100%.

Tensile strength test results

The actual strengths of the gaskets before and after autoclave treatment were measured in accordance with ASTM method F152. Figure 2 shows the tensile strengths after exposure in the autoclave.

Installation assessment

The ease and durability of the gaskets was assessed with a view to their practical application within a plant.

- CAF gaskets; robust and easy to handle, tendency to stick reduced by applying gasket compounds.
- Kevlar gaskets; similar to CAF gaskets to handle, became extremely brittle, cannot use gasket compounds.
- Graphite gaskets; fragile to handle and difficult to install between flanges, tendency to stick, high conductivity can lead to flange face corrosion.
- PTFE gasket; similar to CAF to handle, easily removed.
- Glass fibre gaskets; similar to CAF to handle, tendency to stick, cannot use gasket compounds.

Cost comparisons

Local supply factors can significantly affect the actual cost of each product, however the trends do reflect the type of gasket involved and a comparison against a typical CAF gasket shows all substitutes are significantly more expensive (Fig. 3).

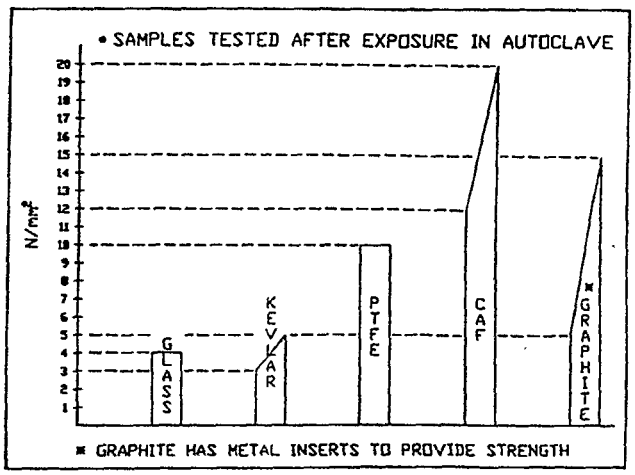

Fig. 2—Tensile strength of gasket materials.

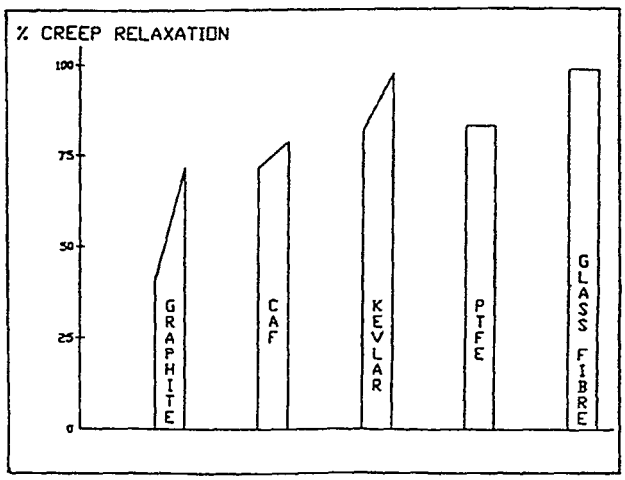

Fig. 1—Creep relaxation of gaskets.

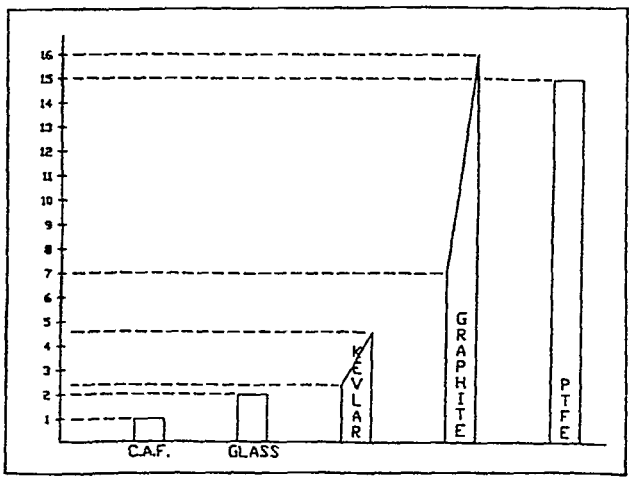

Fig. 3—Comparative cost of gaskets.

CONCLUSIONS

Following the test program a comparison was made with plant experiences at Kinleith and the following conclusions drawn:

- No single universally applicable asbestos-substitute gasket is currently available.
- Glass fibre based gaskets should not be used in weak black liquor applications.
- Kevlar based gaskets are the closest product to CAF gaskets currently available however their lower tensile strength and tendency to become brittle means they should not be used in high pressure/temperature black liquor duties.
- PTFE based gaskets have application in specific duties but require retightening after installation and are very expensive.
- Graphite based gaskets provide good sealing characteristics but are difficult to handle and can cause flange surface corrosion.
- CAF is a safe gasket choice that performs well throughout the plant. The use of CAF gaskets will continue in high temperature/pressure weak black liquor applications.

FUTURE SUBSTITUTE GASKETS

The Kinleith Mills have no intention of becoming the sponsors or test-bed for future gasket material developments by manufacturers. Accordingly we will not consider any future gasket for pulp mill use that has not been subjected to the screening testing program described above and has been shown to have equal or superior performance to CAF.

The gaskets tested have all been sheet type products of similar form to CAF sheets, other gasket types are used on the Kinleith Site. In particular extensive use has been made of spiral wound metal gaskets on steam and liquor duties (our recent pulp mill modernization project specified spiral wound gaskets). On this type of gasket the filler material is contained by the metal winding and its strength property requirements are not as high as in a sheet gasket — consequently the replacement of asbestos fibres as a filler media with other substitute fibres has not resulted in the same difficulties.

Gasket manufacturers are actively working to find suitable asbestos substitute materials especially in the USA where the combined efforts of the Environmental Protection Agency, product liability laws and insurance companies seem likely to eliminate asbestos-containing products in the near future. Secondary users such as valve manfacturers are also examining the impact of substitutes on their products performance and guarantees (the nuclear industry has been very active in this regard). Other factors such as the requirement for gaskets to be fire-safe in the Petroleum industry make the asbestos substitute requirements more difficult than is first apparent. For pressure vessel use the American Pressure Vessel Research Committee are currently reviewing the ASME Code gasket joint factors and requirements and their interim reports indicate major changes are likely in high pressure applications.

Against this background the most prudent course of action for the Australasian pulp and paper industry is to proceed to the use of asbestos-substitute gaskets with extreme caution and continue using CAF in critical applications in the meantime.

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