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NON-ASBESTOS FRICTION MATERIALS--DEVELOPMENT STATUS FEB 1979

VENDOR INCENTIVES

HIGH COMPLIANCE COSTS

POTENTIAL LEGAL/LIABILITY EXPENSES

UNCERTAIN ASBESTOS SUPPLY, COST, QUALITY

INCREASED PROFIT POTENTIAL

POTENTIAL SALES TO GM (WHICH HAS NON-ASBESTOS TARGET DATE)

VENDOR INHIBITIONS

HIGH DEVELOPMENT AND TOOLING COSTS

SHORTAGE OF SKILLED FORMULATORS AND PROCESS ENGINEERS

LIMITED AVAILABILITY OF SOME ALTERNATE MATERIALS

UNKNOWN TOXICITY OF SOME NEW MATERIALS

OTHER FACTORS

UNCERTAIN FUTURE REGULATIONS ON ASBESTOS

POTENTIAL FOREIGN COMPETITION

SCF-FORD-1677

A. E. Anderson 2/14/79
Machining and Wear Dept.
Engg. and Res. Staff

HFM - 004153

ASBESTOS CHARACTERISTICS USED IN FRICTION MATERIALS

<u>PROPERTY</u>	<u>DRY</u>		<u>WET</u>	
	<u>BRAKES</u>	<u>CLUTCHES</u>	<u>CLUTCHES</u>	<u>BANDS</u>
FRICTION	6	6	3	3
WEAR	8	7	2	3
STRENGTH	7	9	2	3
FLEXIBILITY	7(P)	7(P)	2(P)	4(P)
DIM. STABILITY	8	7	1	2
HEAT RESISTANCE	6	6	2	2
CHEM. STABILITY	3	4	-	-
PERMEABILITY	6	5	1	1
HARDNESS	4	4	2	2
FAILURE MODES	6	6	1	1

CODE: 1, Least Important through 10, Most Important for product function

(P) Property important primarily for product processing

- Denotes asbestos, on balance, is believed to have a negative product contribution

A. E. Anderson 2/14/79
Machining and Wear Dept.
Engg and Res. & Inf

ASBESTOS REPLACEMENT CANDIDATES

THERE IS NO KNOWN DIRECT SUBSTITUTE FOR ANY CRITICAL APPLICATION, HENCE NEW FORMULATIONS MUST BE DEVELOPED, OR SUITABLE BLENDS OF FIBERS MUST BE FOUND.

<u>FIBER</u>	<u>(KSI) STRENGTH</u>	<u>(MAX.) TEMP. F</u>	<u>(MAX.) LENGTH</u>	<u>(M²/g) SURF. AREA</u>	<u>(¢/in³) COST</u>	<u>(TONS/YEAR) AVAILABILITY</u>
FIBERGLASS	200	1300	Contin.	0.2	5	250,000
CARBON/GRAPHITE	200	4000	Contin.	0.4	30	500
STEEL WOOL	70	1600	10"	0.01	20	10,000
ARAMID (KEVLAR)	400	700	Contin.	0.2	30	7,500
MINERAL WOOL	150	3200	2"	0.3	3	ADEQUATE
SISAL/COTTON	70	300	0.2"	0.2	2	600,000
WOLLASTONITE	150	2700	0.01"	0.1	0.4	100,000
ASBESTOS	240	1050	1"	60.	3	75,000 (Friction materials only)

The above compilation does not contain all of the necessary properties for asbestos replacement, since many are determined by the choice of structure, binder, and other fillers. Dry friction materials are the most critical in this respect, and are sensitive to Moh hardness, softening temperature, surface energy, pH in water, etc.

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ALTERNATE FIBERS--PROBLEMS FOR DRY FRICTION MATERIALS SUBSTITUTION

FIBERGLASS	PROCESSING--HIGH BULK VOLUME POOR BINDER ADHESION LOW PERMEABILITY MELT/FLOW AT RUBBING INTERFACE
CARBON/GRAPHITE	POOR FRICTION WITH HIGH FILL LEVELS PROCESSING--HIGH BULK VOLUME LOW PERMEABILITY
STEEL WOOL	REQUIRES MORE OXIDATION RESISTANT BINDER CRITICAL WRT WEAR AND RUSTING BEHAVIOR LOW PERMEABILITY, BUT NO PROBLEM FOR SEMIMETS
ARAMID (KEVLAR)	PROCESSING--HIGH BULK VOLUME LOWERS HOT FRICTION POOR BINDER ADHESION LOW PERMEABILITY
MINERAL WOOL	MAY BE ABRASIVE TO CAST IRON AND MILD STEEL BREAKS UP WITH HEAVY MIXING ACTION LOW PERMEABILITY
SISAL/COTTON	LOW TEMPERATURE RESISTANCE WATER SENSITIVITY GREEN FADE AT HIGH FILL LEVELS
WOLLASTONITE	POOR DIMENSIONAL STABILITY LOW STRENGTH, ESPECIALLY BEFORE CURING LOW PERMEABILITY

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Machining and Wear Dept.
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NON-ASBESTOS STATUS FOR DRY FRICTION MATERIALS

<u>PASS. CAR AND LT. TRUCK</u>	ABEX	BENDIX	R-M	THERMOID	THIOLKOL	OTHER U.S.	OTHER FOREIGN
DRUM BRAKES	R	D	D	R	R	U(MET.)	N
DISC BRAKES	R	D*	U	R	D	N	N
CLUTCH FACINGS	N	R	D	U	N	U(MET.)	U(ARAL/KEVLAR)
<u>HEAVY TRUCK</u>							
DRUM BLOCK	D	R	D	N	N	N	N
H.D. DISC BRAKES	R	R	D	N	N	R(MET.)	N
CLUTCH FACINGS	N	N	R	R	N	U(MET.)	N
<u>TRACTOR</u>							
DRUM BRAKES	N	R	R	N	N	U(MET.)	N
CLUTCH FACINGS	N	A	R	D	N	U(MET.)	N

* Semimet linings with resin-asbestos backing now in production usage. Bendix claim a non-asbestos backing material has been found which appears suitable and will be available for testing shortly.

CODES: A Accepted and available
 U Unaccepted, but available
 D Development stage--planned availability for calendar 1979
 R Research stage--planned availability after calendar 1980
 N No known activity

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NON-ASBESTOS STATUS FOR WET FRICTION MATERIALS

<u>CLUTCHES AND DISCS</u>	R-M	BW-SD	OTHER
PAPER TYPE	A	A	N
RESIN/FIBER	R	R	N
RESIN/GRAPHITE	D	N	A
SEMI METALLIC	N(S)	N	N
METALLIC	U	N	A

BANDS

PAPER TYPE	A	A	N
MILLBOARD	A	A	N
RESIN/FIBER	R	N	N
SEMI METALLIC	N(S)	N	N

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A. E. Anderson 2/14/79
 Machining and W. Dept.
 Engg. and Res. Staff

860400

NON-ASBESTOS FRICTION MATERIALS--DEVELOPMENT STATUS FEB 1979

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POTENTIAL FOREIGN COMPETITION

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Machining and Wear Dept.
Engg. and Res. Staff

PRODUCED BY FORD

HFM - 004159

660700

ASBESTOS CHARACTERISTICS USED IN FRICTION MATERIALS

PROPERTY	DRY		WET	
	BRAKES	CLUTCHES	CLUTCHES	BANDS
FRICTION	6	6	3	3
WEAR	8	7	2	3
STRENGTH	7	9	2	3
FLEXIBILITY	7(P)	7(P)	2(P)	4(P)
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A. E. Anderson 2/14/79
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Engg and Res. & Dev.

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HFM - 004160

004100

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HFM - 004161

104101

ALTERNATE FIBERS--PROBLEMS FOR DRY FRICTION MATERIALS SUBSTITUTION

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HFM - 004162

004102

NON-ASBESTOS STATUS FOR DRY FRICTION MATERIALS

PRODUCED BY FORD

<u>PASS. CAR AND LT. TRUCK</u>	ABEX	BENDIX	R-M	THERMOID	THIOL	OTHER U.S.	OTHER FOREIGN
DRUM BRAKES	R	D	D	R	R	U(MET.)	N
DISC BRAKES	R	D*	U	R	D	N	N
CLUTCH FACINGS	N	R	D	U	N	U(MET.)	U(ARAL/KEVLAR)
<u>HEAVY TRUCK</u>							
DRUM BLOCK	D	R	D	N	N	N	N
H.D. DISC BRAKES	R	R	D	N	N	R(MET.)	N
CLUTCH FACINGS	N	N	R	R	N	U(MET.)	N
<u>TRACTOR</u>							
DRUM BRAKES	N	R	R	N	N	U(MET.)	N
CLUTCH FACINGS	N	A	R	D	N	U(MET.)	N

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HFM - 004163

004103

NON-ASBESTOS STATUS FOR WET FRICTION MATERIALS

<u>CLUTCHES AND DISCS</u>	R-M	BW-SD	OTHER
PAPER TYPE	A	A	N
RESIN/FIBER	R	R	N
RESIN/GRAPHITE	D	N	A
SEMI METALLIC	N(S)	N	N
METALLIC	U	N	A

BANDS

PAPER TYPE	A	A	N
MILLBOARD	A	A	N
RESIN/FIBER	R	N	N
SEMI METALLIC	N(S)	N	N

CODES: A Accepted and available
 U Unaccepted, but available
 D Development stage--planned availability for 1979
 R Research stage--planned availability after 1980
 N No known activity

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