ASBESTOS CONVERSION PROCESS (ACP)

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Abstract

The Asbestos Conversion Process by ARP transforms asbestos fibres to inert products of natural character. This process gives no asbestos-dust problems. A wet mixing technology is used. The asbestos slurry is mixed with plastic clay in a capsuled mixer resulting in pellets or paste. This product is dried and preheated combined with the following conversion process using the waste gas, or separatly in a dryer drum to achieve granulates. The transformation of asbestos-clay-granulates to inert products of natural composition is done by a thermal process and controlled cooling. In order to lower the conversion temperature high alumina plastic clay is necessary. The ratio of clay to asbestos waste is choosen depending on the chemical analysis and the proposed character of the end product. The structure of the resul-ting product depends on the cooling conditions. Slow cooling results in crystalline products, compareable with pyroxene. Fast cooling results in glass (slag) or micro crystalline products compareable with basalt. The products are used as compareable natural rocks.

Application of fibres and mineralogical reflections

Fibres are used in building material industry for insulation purposes. Synthetic fibres are created out of glass or mineral meltings. The natural mineral fibre asbestos has the additional advantage of fire resistancy and its increasing influence on the flexural strength of materials - but out of the same properties which made asbestos so famous and worthful it is noxious and a health hazard. A couple of years ago the usage of asbestos was stopped therefore all over the world, but a lot of buildings are now still a big problem for mankind.

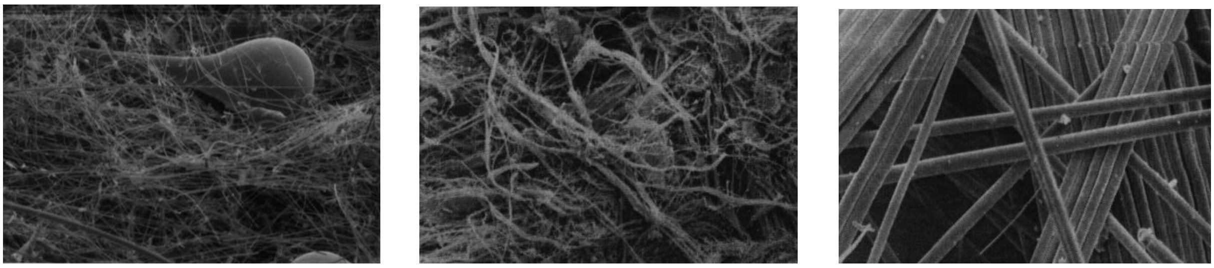

Figure 1 : microscopy of different fibres (mineral-250x, asbestos-500x, glass-250x)

Looking on mineral and chemical composition of this remarkable group of minerals a thermal treatment seems to be the best way for treatment of asbestos waste.

	Chrysotile		Antophyllite		Tremolite		Crocidolite	
	Mol	M-%	Mol	M-%	Mol	M-%	Mol	M-%
MgO	3	43,0	5	23,8	5	24,5	-	-
SiO_2	2	44,1	8	57,0	8	58,9	8	49-57
CaO	-	-	-	-	2	13,8	-	
FeO	-	-	-	-	-		3	40
Fe_2O_3	-	-	2	17,1	-		2	
Na_2O	-	-	-	-	-		2	2-8
H_2O	2	12,9	1	2,1	1	2,8	1	2-4
g/cm^3	2 - 2,6		2,8 - 3,2		2,9 - 3,0		3 - 3,4	

Figure 2 : Chemical compositions of different asbestos minerals

The thermal behaviour of chrysotil is shown in in the DTA/TG-Diagramm in figure 3: slowly dewatering until 550°C (-2%), loss of mineral water between 600 and 700°C (-9%), structure breakdown at 810°C.

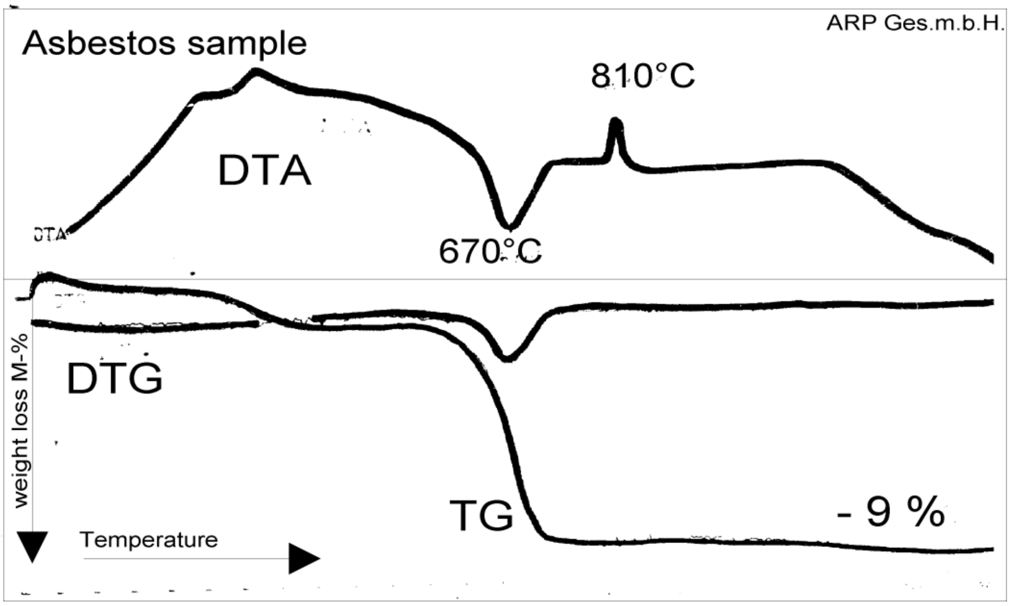

Figure 3 : DTA/TG of asbestos

The two phase diagramm MgO - SiO_2 shows that the lowest eutecticum is at 1543°C, so that melting has to be excecuted with additives.

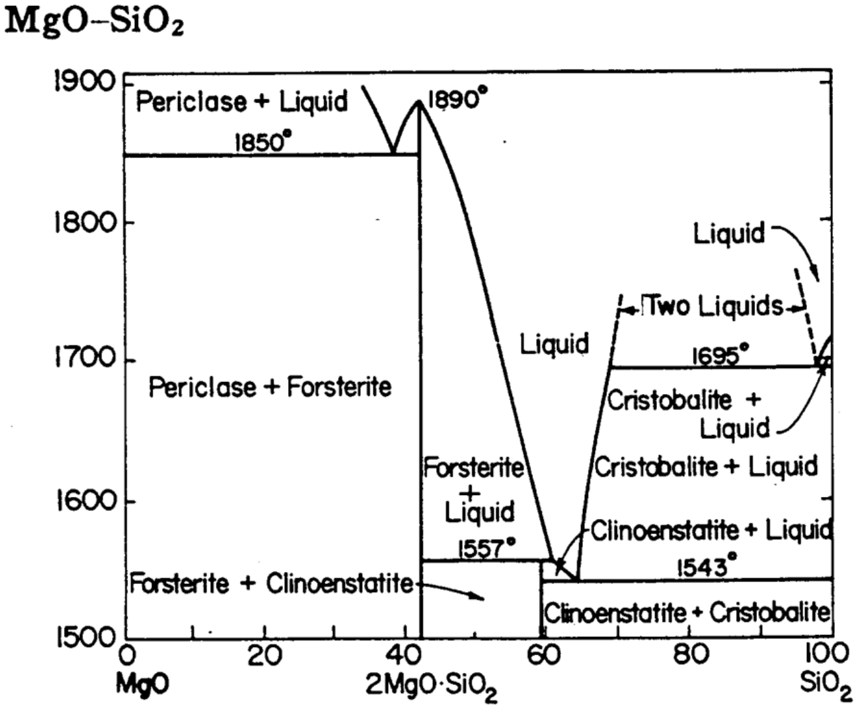

Figure 4 : Phase diagramm MgO - SiO_2

The additives are choosen to decrease the melting temperature, to destroy the fibre structure of asbestos, to change chemistry and to achieve new product properties.
A probable target mineral group are the melilithes. The Melilithe are minerals between the two ternary compounds Akermanite (C_2MS_2) and Gehlenite (C_2AS). Figure 5 shows the schematic situation of Melilithe in the quartenary system of MgO - SiO_2 - CaO - and Al_2O_3 in natural mixtures of asbestos wastes and additives also FeO, Fe_2O_3, Na_2O have to be taken into consideration.

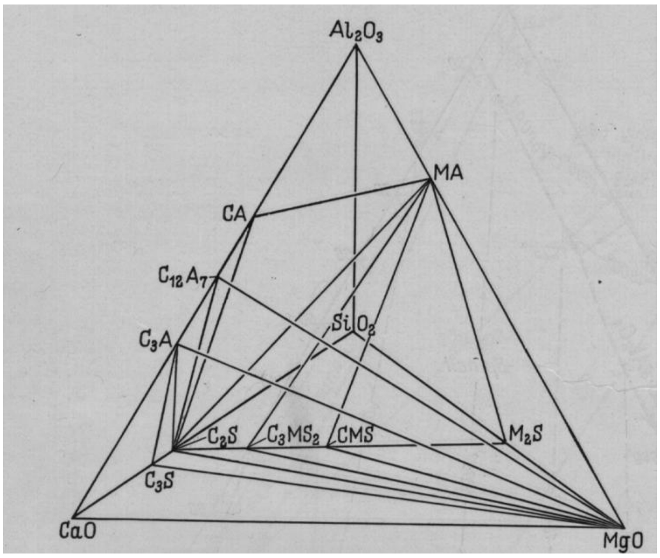

Figure 5 : Phase diagramm C - M - S - A / Melilithe

Figure 6 : microscopy of Melilithe crystals in glassy matrix

Disassembling and primary treatment

Suitable additives (e.g. clay slurry) are gunned for dust absorption or combined in a capsuled mixer on site to prepare material for secure handling and transport.

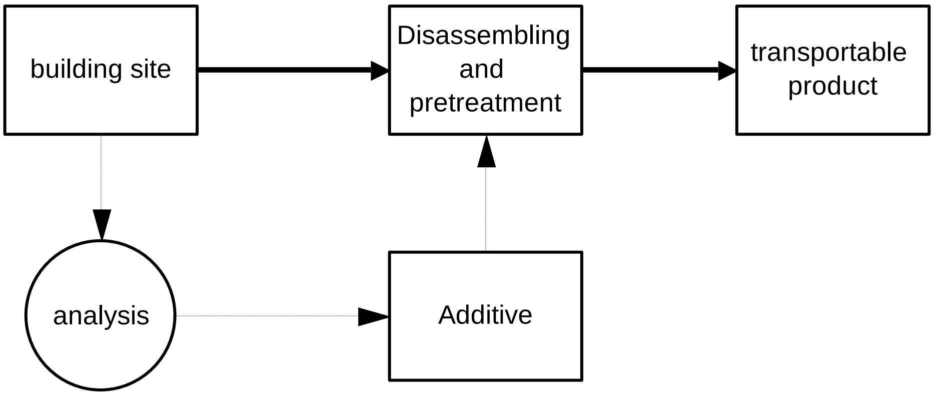

Figure 7 : ACP-process on site

Virtrification and ceramisation

Drying, preheating and vitrification is done in a three stage thermal process:

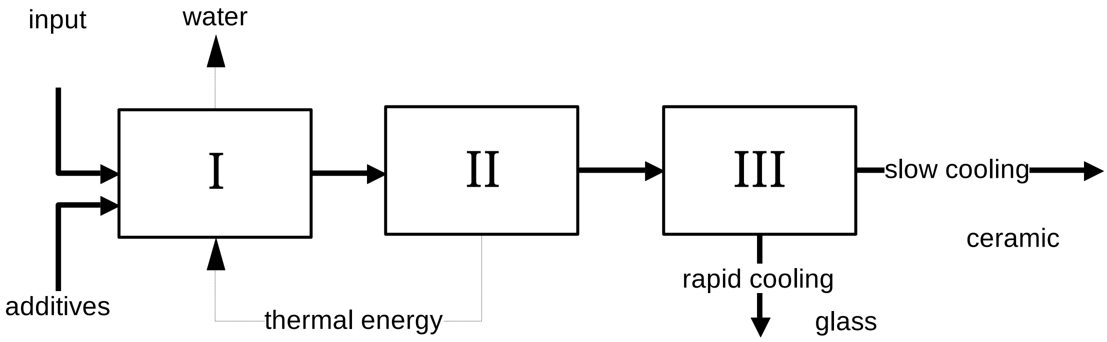

Figure 8 : ACP-process thermal stage

Additives for melilthe composition

Depending on kind of asbestos and chemical composition of building material (e.g. insulating boards, concrete sheets....) additives are choosen to reach a target product composition.
e.g. clays (Al, Si,...), slags (Si, Ca,...), glass (Si, Ca, Na,...)

Products and applications

Possible products in that range of compositions are gravels, concrete aggregates, abrasives, or at least fibres - but fibres without any bad influence on humans health. The next figure gives a calculation example how to produce mineral fibres out of asbestos plates with two different slags and a clay used as additives.

	50%	20%	15%	15%	mineral
	asbestos board	clay	slag I	slag II	fibre
SiO_2	50	55	41	17	44.70
Al_2O_3	7	39	10	2	13.10
CaO	3	1	32	45	13.25
MgO	32	1	10	5	18.45
Na_2O	1	1	3	0	1.15
Fe_2O_3	7	3	4	31	9.35

Figure 9 : calculation example for production of fibres

Figure 10 : Fibre production out of asbestos waste