

Señores

Superintendencia de Industria y Comercio

Dirección de Nuevas Creaciones

E. S. D.

Ref: Expediente No. NC2017/0005627.

Solicitud de registro de Patente de Invención denominada “PANEL DE YESO QUE COMPRENDE FIBRA DE VIDRIO, ACETATO DE POLIVINILO Y ALMIDÓN”.

Solicitud PCT No. PCT/GB2015/053538.

Solicitante: SAINT-GOBAIN PLACO SAS.

Luz Helena Adarve, identificada como aparece al pie de mi firma, y obrando en mi condición de apoderada de **SAINT-GOBAIN PLACO SAS**, solicitante de la patente en referencia, a continuación doy respuesta al Oficio **No. 1443** del 20 de marzo de 2019.

1. Respecto al Título de la solicitud

En el numeral 2.1 del oficio No. **1443**, se presentan las siguientes observaciones sobre el título de la solicitud:

“El nombre de la invención de que se trata en el artículo 27 literal d) de la Decisión 486 deberá reflejar el objeto y el campo industrial con el cual se relaciona la misma y ser concordante con la materia descrita y las reivindicaciones de la solicitud. El nombre no podrá referirse a nombres personales, marcas de productos o nombres de fantasía.

El solicitante en el escrito radicado bajo el N° NC2017/0005627 el 09 de agosto de 2017, solicitó la modificación del título a: “PANEL DE YESO QUE COMPRENDE DOS ADITIVOS POLIMÉRICOS”, la cual es general y no se ajusta completamente al objeto reclamado. Teniendo en cuenta lo anterior,

se sugiere el título siguiente: "PANEL DE YESO QUE COMPRENDE FIBRA DE VIDRIO, ACETATO DE POLIVINILO Y ALMIDÓN" "

Con el objetivo de superar esta objeción, es deseo del solicitante hacer las siguientes modificaciones al título que corresponden a las sugeridas por el examinador:

"PANEL UN PRODUCTO DE YESO QUE COMPRENDE DOS ADITIVOS POLIMÉRICOS FIBRA DE VIDRIO, ACETATO DE POLIVINILO Y ALMIDÓN"

Quedando el título de la siguiente forma:

"PANEL DE YESO QUE COMPRENDE FIBRA DE VIDRIO, ACETATO DE POLIVINILO Y ALMIDÓN"

2. Respecto a las Descripción (Art. 28 D486).

En el numeral 2.2 del oficio No. **1443**, se presentan la siguiente objeción a la claridad de la Descripción:

"En las páginas 8 a 12, en los ejemplos, se hace referencia a los nombres comerciales "Mowilith S1", "C Flex 03408", "Vinamul 8481", "Merifilm 102", "Coatmaster K57F", los cuales no definen correctamente los productos, porque su composición puede cambiar con el paso del tiempo aunque conserve el mismo nombre. Se sugiere aclarar cuáles son las características de los productos en cuestión"

Sobre esto queremos aclarar que la descripción de la solicitud de acuerdo con lo establecido en el Artículo 28 está correctamente definida porque divulga la invención de manera que la persona del oficio la comprende y la puede ejecutarla, además de comprender toda la información exigida en dicho Artículo.

Particularmente se debe resaltar que, a pesar que en los ejemplos se utilizan los acetatos de polivinilo correspondientes a "Mowilith S1" y "Vinamul 8481", y los almidones correspondientes a "C Flex 03408", "Merifilm 102", "Coatmaster K57F", la invención se puede implementar con otros acetatos de polivinilo u otros almidones existentes en el mercado y de acuerdo a la descripción de la solicitud, en donde la persona del oficio con base en la descripción de la solicitud puede fácilmente identificar los acetatos o almidones con los que se puede implementar la invención.

Los aditivos descritos por su nombre comercial utilizados en los ejemplos de la solicitud son solo ejemplos de implementaciones que se realizan con el objetivo de comprobar las ventajas técnicas de la invención, pero la invención no requiere indispensablemente que se utilicen específicamente dichos aditivos con dicho nombre comercial y por lo tanto no es necesario que la descripción indique las particularidades de los aditivos vendidos bajo un nombre comercial en particular para que la persona del oficio pueda implementar la invención.

Los almidones nombrados se incluyen como Ejemplos y Ejemplos Comparativos, en donde dichas implementaciones en los ejemplos demuestran que la composición particular no es un factor clave para determinar las propiedades del tablero de yeso que solucionan el problema técnico. En su lugar, los ejemplos y los ejemplos comparativos demuestran que es la proporción de almidón que se incorpora en la placa de yeso la que tiene el mayor impacto en sus propiedades.

En conclusión, independientemente si se especifican las particularidades de los aditivos vendidos bajo un nombre comercial en particular, la persona del oficio puede implementar la invención sin problema.

Sin embargo con el fin que sea más claro que la descripción de la solicitud cumple con lo establecido en el Artículo 28 de la Decisión 486, junto con este memorial se presenta las fichas técnicas correspondientes a “Mowilith S1” y “Vinamul 8481”, y se da los enlaces web e información descriptiva de los aditivos “C Flex 03408”, “Merifilm 102” y “Coatmaster K57F”.

Aunque las anteriores fichas técnicas se aportan en su idioma original, en inglés, a continuación se presenta en español la información relevante relativa a la composición de dichos compuestos.

Por su parte, en la sección 3, página 1, de la ficha técnica de “Vinamul 8481” aclara que su composición corresponde a:

<u>SECCIÓN 3: Composición / información sobre los ingredientes.</u>		
Componentes	CAS-No	Porcentaje %
Polímero de acetato de vinilo		54 - 56
Agua	7732-18-5	44 - 46

En la sección 3, página 2, de la ficha técnica de “*Mowilith S1*” se aclara que su composición corresponde a:

SECCIÓN 3: Composición / información sobre los ingredientes.				
Caracterización química: Emulsión polimérica a base de agua. Base: acetato de vinilo sin plastificante.				
3.1. Sustancias no aplicables				
3.2. Mezclas ver Caracterización química.				
Componentes	CAS-No	EC-No.	Número de Identificación	Porcentaje %
1,2-Benzisotiazol-3(2H)-ona	2634-33-5	220-120-9***	613-088-00-6***	0.0152
Mezcla de: 5-cloro-2-metil-4-isotiazolín-3-ona [EC No. 247-500-7] y 2-Metil-2H-isotiazol-3-ona [EC No. 220-239-6] (3: 1)	55965-84-9	247-500-7 + 220-239-6	613-167-00-5	0.0014
2-Metil-2H-isotiazol-3-ona	2682-20-4	220-239-6***		0.0152

Adicionalmente sobre los componentes “*C Flex 03408*”, “*Merifilm 102*” y “*Coatmaster K57F*” en los siguientes enlaces se puede obtener información sobre ellos:

- C Flex 03408 – Es un almidón para el tratamiento de superficie en donde el tratamiento de la superficie del papel se refiere a la aplicación de almidón por medio de una prensa de apresto o prensa de película. Ver más información en el siguiente enlace:
<https://www.cargill.com/bioindustrial/surface-treatment-starches>
- Merifilm 102 – Es un almidón de maíz modificado que se utiliza en la industria de fabricación de papel para aumentar la resistencia del papel en seco y mejorar las condiciones de su superficie, además de utilizarse como aglutinante en recubrimientos de papel. Ver más información en el siguiente enlace:
<https://www.tateandlyle.com/ingredient/merifilm-modified-corn-starch>
- Coatmaster K57F – Es un almidón propilado para la aplicación en superficie. Ver más información en el siguiente enlace:
<http://www.grainprocessing.com/industrial-starch-products/ethylated-starches.html>

3. Respecto a la Determinación del Estado de la Técnica y al Examen de Patentabilidad

En los numerales 3, 4 y 5 del oficio citado, ese Despacho concluye que las reivindicaciones de la presente solicitud de patente carecen de nivel inventivo frente a las enseñanzas de los documentos **US 2005/0126437 (D3)** y el artículo **“Physical and Mechanical Properties of PVAc-Gypsum Composite”¹ (D4)**.

3.1. Novedad

El nuevo capítulo reivindicatorio de la solicitud es novedoso de acuerdo con el análisis de patentabilidad presentado en el del oficio No. **1443** porque, de acuerdo a dicho análisis, ninguna de las anterioridades divulga completamente la materia reclamada en la solicitud.

Ninguno de los documentos D3 ni D4 describen placas de yeso con todas las características requeridas por la Reivindicación 1 de la solicitud.

El documento D3 no describe *“Un panel de yeso que comprende... acetato de polivinilo”*. Además, el documento D3 tampoco describe un *“panel de yeso tiene fibras de vidrio introducidas en él en una cantidad mayor a 2 %p y menor que 10 %p con relación al yeso”*. Los párrafos [0046], [0075] y [0077] del documento D3 describen fibras de vidrio en una cantidad de 2% en peso con respecto al estuco. Sin embargo, la hidratación del estuco, convirtiéndolo en yeso, durante la fabricación de placas de yeso significa que las fibras de vidrio provistas al “2% en peso con respecto al estuco” corresponden a proporcionar 1,7% en peso con respecto al yeso de un panel de yeso. En consecuencia, el documento D3 no revela la cantidad requerida de fibras de vidrio en la reivindicación 1. Las únicas otras descripciones con respecto a la proporción de fibras de vidrio en el documento D3 también revelan el uso de cantidades menores a las requeridas por la Reivindicación 1 (véanse los párrafos [0076] y [0079] que describen un 1,3 y un 0,84% en peso de fibras de vidrio en relación con el yeso, respectivamente).

Por su parte, el documento D4 no describe *“Un panel de yeso que comprende... almidón”* como se exige en la Reivindicación 1. Además, el documento D4 tampoco describe fibras de vidrio al 2% en peso con respecto al yeso. En su lugar, el documento

¹ Tariq S., Atheer A., y Suhad A. (2011). *Physical and mechanical properties of PVAc-gypsum composite*. *Al - Mustansiriyah J. Sci.* 22 (Nº. 4).

D4 menciona brevemente que las fibras de vidrio se pueden incluir en el material de yeso y cita un artículo para apoyar esta posición: **Artículo 2** ([7] - J. Bijen, Vanderplas, “Yeso reforzado con fibra de vidrio modificado con polímero”, Mater. Struct. 25,107 (1992)). Para su rápida referencia adjuntamos una copia de este documento junto con este memorial. El artículo 2 especifica que las fibras de vidrio pueden incluirse en un 13% en peso con respecto a la matriz total en materiales de yeso que comprenden dispersiones de polímeros, que es un 20% en peso con respecto al yeso después de la hidratación del estuco (alpha-hemihydrate) convirtiéndolo en yeso. En consecuencia, el documento D4 y el Artículo 2 juntos enseñan que las fibras de vidrio deben incluirse en un panel de yeso al 20% en peso con respecto al yeso.

El Artículo 2 en su página 107, columna derecha, establece que:

La composición contiene 13% en peso de fibra E-glass. En comparación con otras composiciones inorgánicas, este es un nivel relativamente alto. Sin embargo, la reología de la matriz de yeso asegura una fácil aplicación; Fluye sin segregación e incorpora fácilmente las fibras. Las muestras se realizaron mediante aspersión manual o mediante colocación de esteras de fibra de vidrio. Para fines de comparación, las composiciones GRG simples también se hicieron sin polímero o con un polímero elastomérico. Estas composiciones también se dan en la Tabla 1. Los materiales compuestos se curaron durante 1 a 7 días a 30% y 40% de HR.

Tabla 1 composiciones de PGRG en porcentajes en peso

Componente	Forton-Jesmonita PGRG	GRG Plano	Polímero-Modificado Elastomérico PGRG
α- Hemihidrato de yeso	54,5	73,7	54,5
Dispersión polimérica			
Compuesto de Forton VF812 ^a	38,5	-	-
Compuesto de Forton VF774 ^b	-	-	38,5
Agua	-	26,3	-
Melamina	5,4	-	5,4
Agente antiespumante	1,2	-	1,2
Catalizador	0,27	-	0,27
Retardador	0,01 (3)	0,01 (3)	0,01 (3)
Fibras de vidrio	13,0	13,0	13,0
(Porcentaje en peso del total de la matriz)			

^a VF812 es una emulsión de polímero acrílico reticulable especialmente desarrollada para yeso modificado con polímeros.
^b VF774 es una emulsión de polímero acrílico no reticulable especialmente desarrollado para cemento modificado con polímeros.

Por consiguiente, ninguno de los documentos D3 y/o D4, o el artículo 2, describen un panel de yeso que comprenda todas las características de la presente invención.

3.2. Nivel Inventivo

El solicitante considera que el documento D3 es el estado de la técnica más cercano a

la invención de la reivindicación 1, ya que a partir de los documentos resaltados constituye el punto de partida más prometedor para un desarrollo que conduzca a la invención de la reivindicación 1.

Como se explicó anteriormente, la presente invención difiere del documento D3 en al menos que la Reivindicación 1 requiere:

- i. *“Un panel de yeso que comprende... acetato de polivinilo”; y*
- ii. *Un "panel de yeso tiene fibras de vidrio introducidas en él en una cantidad mayor a 2 %p y menor que 10 %p con relación al yeso".*

Estas características distintivas se combinan para proporcionar el efecto técnico de aumentar la resistencia del panel de yeso, de modo que los medios de fijación insertados en la placa de yeso (por ejemplo, los tornillos) se retienen de manera más efectiva, como se detalla en las páginas 1 y 2 de la Descripción de la solicitud. Como tal, el problema técnico resuelto por la presente invención que se reclama es la provisión de un panel de yeso con una mayor resistencia de fijación.

Se indica que la persona del oficio medianamente versada en la materia no consideraría la inclusión del acetato de polivinilo **y adicionalmente** las fibras de vidrio incrustadas en una cantidad superior al 2% y menor del 10% en peso con respecto al yeso como una solución obvia al problema de mejorar la resistencia de fijación partiendo del documento D3.

El documento D3 no proporciona información sobre la inclusión del acetato de polivinilo en paneles de yeso para mejorar la retención del tornillo, ni por cualquier otro motivo técnico. Más bien, el documento D3 enseña en su párrafo [0046] que el "*copolímero de etileno y acetato de vinilo*" (un polímero relacionado con el acetato de polivinilo) se puede usar para aplicar una capa de imprimación a las superficies de los paneles de yeso para pintar. Como tal, cualquier lectura de D3 solo llevaría a la persona del oficio a aplicar acetato de polivinilo como un recubrimiento a las superficies del panel de yeso y no lo incluiría dentro del mismo panel de yeso.

De lo anterior la persona del oficio no se preocuparía por establecer un porcentaje de acetato de vinilo con relación al yeso debido a que el recubrimiento de la superficie no requiere formular dicha proporción.

Además, el documento D3 no contiene información sobre la incorporación de fibras en el panel de yeso fuera de los párrafos [0046] y [0075] a [0079]. En ninguna parte de esta descripción, el documento D3 enseña, insinúa o sugiere que la implementación de fibras de vidrio incrustadas en una cantidad entre el 2% y el 10% en peso con respecto al yeso mejore la retención de medios de fijación, por ejemplo la retención de tornillos.

Por lo tanto, el solicitante sostiene que el documento D3 no contiene ningún indicador que lleve a la persona del oficio a proporcionar un panel de yeso que contenga acetato de polivinilo o la cantidad reclamada de fibras de vidrio, y mucho menos un panel de yeso que comprenda estas dos características simultáneamente.

Dado lo anterior, la persona del oficio medianamente versada en la materia requeriría documentos adicionales al intentar proporcionar la presente invención que se reclamada. Sin embargo, incluso si la persona del oficio estuviera motivada a buscar las enseñanzas de otros documentos para proporcionar la presente invención de la solicitud, aclaramos que la persona experta no combinaría las enseñanzas de los documentos D3 y D4.

En primer lugar, el documento D4 enseña que el acetato de polivinilo se puede incluir en un panel de yeso. Sin embargo, el documento D4 enseña que la proporción de acetato de polivinilo incluido en un panel de yeso aumenta la compresión y el módulo de elasticidad, pero disminuye la resistencia a la flexión. Por lo tanto, dicho documento D4 enseña que el acetato de polivinilo puede impactar negativamente en la resistencia del panel. El documento D4 no proporciona ninguna enseñanza sobre la resistencia de fijación y la retención de tornillos. Como tal, la persona experta no consideraría el documento D4 ni buscaría combinar sus enseñanzas con el documento D3 para mejorar la resistencia de fijación de un panel de yeso.

En segundo lugar, como se mencionó anteriormente, el documento D4 solo enseña que las fibras de vidrio pueden ser incluidas para su fortalecimiento haciendo referencia al Artículo 2. La persona del oficio consultará las enseñanzas del Artículo 2 respecto a la incrustación de fibras de vidrio en paneles de yeso. Sin embargo, la cantidad de fibras de vidrio descritas en el Artículo 2 (20% en peso en relación con el yeso) es mucho mayor que el rango requerido por la Reivindicación 1. En consecuencia, cualquier combinación del documento D3 con el Artículo 2 no llevaría a la persona experta a proporcionar la Cantidad de fibra de vidrio.

Además, el Artículo 2 solo describe el uso de polímeros acrílicos y no describe un panel de yeso que contenga acetato de polivinilo como lo exige la Reivindicación 1. Por lo

tanto, cualquier intento de proporcionar la presente invención requeriría que la persona del oficio combine las enseñanzas de los documentos D3, D4 y el Artículo 2. Sin embargo, la persona del oficio partiendo de los documentos señalados no tiene ninguna motivación o indicio de que alguna de las características divulgadas, ya sea de forma individual o combinada, mejore la retención de tornillos en el panel de yeso. Como tal, el solicitante sostiene que la presente invención solo puede considerarse obvia como resultado del análisis retrospectivo.

De lo anterior, se indica que la Reivindicación 1 es novedosa es inventiva. Todas las demás reivindicaciones dependen de la Reivindicación 1, por lo tanto, y por lo menos por las razones descritas anteriormente, son novedosas e inventivas sobre la técnica anterior citada por el examinador.

4. Conclusión

Las aclaraciones presentadas a lo largo del presente escrito, permiten superar completamente las objeciones realizadas a la claridad de la Descripción, por lo cual, la presente solicitud cumple a cabalidad las exigencias establecidas por el artículo 28 de la Decisión 486 según los requerimientos del Examinador.

De otra parte, los argumentos expuestos en el numeral 3 del presente escrito, ponen de manifiesto de una manera clara y contundente, que lo revelado en las reivindicaciones de la presente solicitud, resulta completamente NOVEDOSO E INVENTIVO sobre las enseñanzas del estado del arte más cercano representado por los documentos D3 y D4, toda vez que nada dentro de dichos documentos revela en forma directa o al menos llega a sugerir la materia de la reivindicación independiente 1.

En consecuencia, me permito solicitar a ese Despacho, proceder con la revisión de los argumentos aquí presentados, para conceder el privilegio de patente solicitado para la materia objeto de las 3 reivindicaciones de la solicitud, y que de subsistir alguna duda o inquietud respecto a la patentabilidad de la presente invención, a pesar argumentos técnicos ahora presentados, sin apartarse del espíritu inventivo originalmente revelado en la solicitud internacional, se le brinde la oportunidad al solicitante de aclararla o de limitar la invención, mediante la emisión de un segundo examen de fondo, antes de que se emita una decisión definitiva por parte de ese Despacho, de conformidad con lo dispuesto en 1.2.2.5.1 del artículo primero de la Resolución 54093 de 2012.

5. Anexos

- Ficha técnica de Mowilith S1.
- Ficha técnica de Vinamul 8481.
- Artículo 2: [7] - J. Bijen, Vanderplas, "Yeso reforzado con fibra de vidrio modificado con polímero", Mater. Struct. 25,107 (1992).

Petición

Solicito al Despacho, y en el evento que el examinador considere que pese a los argumentos presentados aún existen objeciones, que proceda a emitir un segundo examen de fondo.

En este sentido, y de acuerdo con lo establecido en el inciso segundo del numeral 1.2.2.5.1 del Capítulo Primero del Título X de la Circular Única, requiero se me comunique a través del SIPI o cualquier otro medio la existencia de estas objeciones para, de esta manera, proceder a realizar el nuevo pago del examen de patentabilidad de la solicitud de la referencia.

Atentamente,



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FJG

P-917

Polymer-modified glass fibre reinforced gypsum

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Glass fibre reinforced gypsum, modified by addition of specially selected and developed thermosetting polymers, is the basis of a new composite material, called PGRG. An investigation has been performed into its mechanical properties such as bending strength, tensile strength and long-term performance under constant load and fatigue load. The influence of moisture and temperature on mechanical properties has been determined. The equilibrium moisture content at various relative humidities, the moisture content under natural weathering conditions, the coefficient of linear expansion and the microstructure have been studied. Furthermore, the durability has been investigated under accelerated ageing conditions and outdoor exposure. The results have shown that the polymer-modified glass fibre reinforced gypsum has good mechanical properties under tension and, unlike unmodified gypsum, is resistant to the Western European climate. A variety of new outdoor applications for gypsum are likely to be possible now. The material has already been used successfully for outdoor applications in the UK, the Middle East and The Netherlands.

1. INTRODUCTION

Gypsum lends itself quite well to reinforcement with common E-glass fibres. Unlike cement, gypsum has no high alkalinity and no lime deposit, which are the main causes of degradation of glass fibre reinforced cement (GRC). Therefore gypsum has an enormous advantage compared with unmodified cement matrices. However, a disadvantage of gypsum is its poor weather resistance. Because of this, unmodified gypsum is only suitable for indoor use.

In the United Kingdom a new material has been developed, based on glass fibres, α -hemihydrate gypsum and a thermosetting polymer, which shows remarkably good weather resistance. The basic idea was licensed by Forton BV in The Netherlands; the trade name of this new gypsum material is Forton-Jesmonite polymer-modified glass fibre reinforced gypsum, in this article called PGRG. A major research and development programme has been started by Forton through INTRON BV in cooperation with Delft University of Technology and managed by the Civil Centre for Research and Regulations [1]. In this paper some of the results of this research programme are presented.

2. MATERIALS/COMPOSITIONS/CURING

A preliminary composition for PGRG is shown in Table 1 (first column). The polymer in the dispersion is a thermosetting acrylic which interacts with a melamine resin. A catalyst and an anti-foaming agent are necessary additives.

The composition contains 13 wt% of E-glass fibre. Compared with other inorganic compositions this is a relatively high level. However, the rheology of the gypsum matrix assures easy application; it flows without segregation and easily incorporates the fibres. The samples were made either by hand spraying or by lay-in of glass fibre mats. For the purpose of comparison, plain GRG compositions were also made without polymer or with an elastomeric polymer. These compositions are also given in Table 1. The composites were cured for 1 to 7 days at 30°C and 40% RH. Subsequently they were stored at 20°C and

Table 1 PGRG compositions in weight percentages

Component	Forton-Jesmonite PGRG	Plain GRG	Elastomeric polymer-modified PGRG
α -Hemihydrate gypsum	54.5	73.7	54.5
Polymer dispersion			
Forton compound VF812 ^a	38.5	-	-
Forton compound VF774 ^b	-	-	38.5
Water	-	26.3	-
Melamine	5.4	-	5.4
Anti-foaming agent	1.2	-	1.2
Catalyst	0.27	-	0.27
Retarder	0.01 (3)	0.01 (3)	0.01 (3)
Glass fibres (wt% of total matrix)	13.0	13.0	13.0

^a VF812 is a cross-linkable acrylic polymer emulsion specially developed for polymer-modified gypsum.

^b VF774 is a non-cross-linkable acrylic polymer emulsion specially developed for polymer-modified cement.

65% RH. No substantial influence has been found from the length of the period of curing at 30°C from 1 to 7 days. The properties presented in this paper could be for slightly different compositions than those given in Table 1, since for the early tests experimental versions of the Forton VF812 compound were used, mainly having a somewhat lower solid content. Also the total amount of polymer used was somewhat less in the early days (5%). For the test results presented in this article these results only concern the Weather-o-meter exposure test. In order to restrict the length of this paper and not to confuse the reader, these different compositions will not be discussed here.

3. MECHANICAL PROPERTIES

Four-point bending tests were performed according to RILEM recommendations [2]. The tensile stress-strain tests were done in accordance with those described elsewhere [1] at a crosshead speed of 2 mm min⁻¹. The impact resistance was measured with a Charpy impact device for unnotched samples [2].

Fig. 1 shows a typical tensile stress-strain curve for dry PGRG. Further results for the dry material are given in Table 2 (first column). The tensile strength, modulus of rupture and ductility of PGRG appear to be substantially higher than for 28-day-old GRC or polymer-modified GRC (PGRC), of which the properties are also given in Table 2 for the purpose of comparison [3].

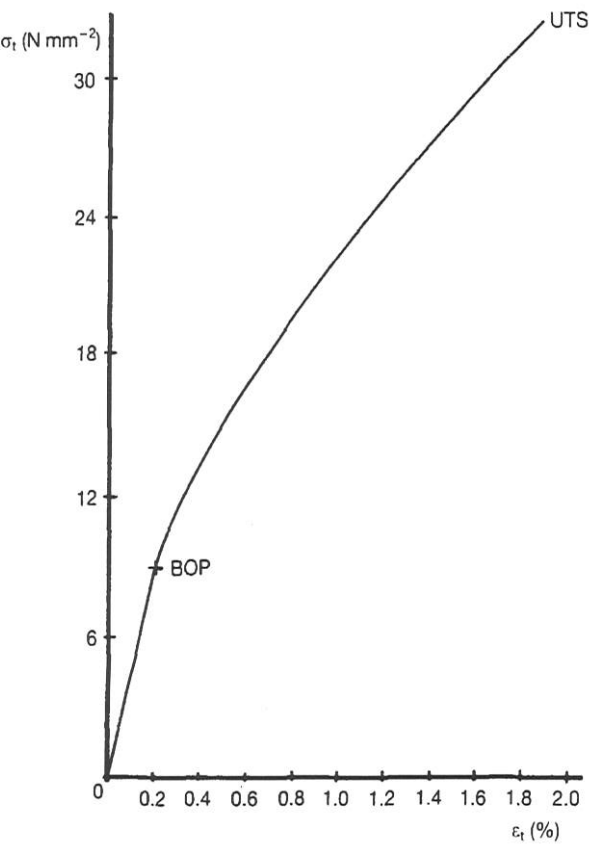


Fig. 1 Tensile stress-strain curve of dry PGRG.

Table 2 Mechanical properties of dry PGRG, PGRC and GRC at 28 days

Material property	PGRG	PGRC	GRC
MOR (N mm ⁻²)	75	30	26
LOP (N mm ⁻²)	25	13	9
ϵ_{MOR} (%)	2.5	0.6	1.0
UTS (N mm ⁻²)	32	13	12
BOP ^a (N mm ⁻²)	9	6	6
ϵ_{UTS} (%)	1.8	0.5	1.0
Charpy impact			
strength (kJ m ⁻²)	31	6	20
Density (kg m ⁻³)	1500	1850	1950

^a Bending-over point.

3.1 Moisture sensitivity

Gypsum is known to be a moisture-sensitive material. When used outdoors the mechanical properties can deviate substantially from those in indoor use. Therefore knowledge of the actual moisture content and the properties related to these PGRG moisture contents is of major importance for correct assessment of the engineering feasibility of PGRG.

Fig. 2 shows the equilibrium moisture content of PGRG as a function of relative humidity at 20°C. Fig. 3 shows a photograph of outdoor exposure racks at the INTRON laboratories. PGRG sheets were exposed on

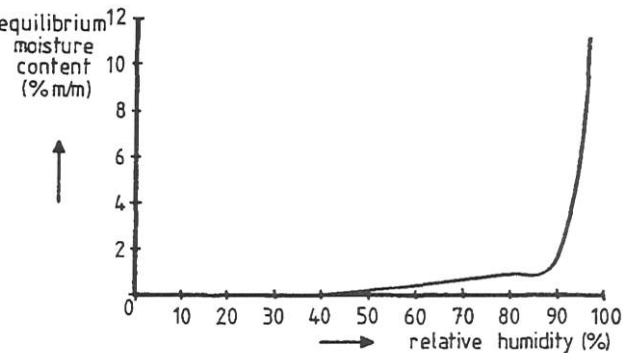


Fig. 2 Equilibrium moisture content of PGRG as a function of relative humidity at 20°C.

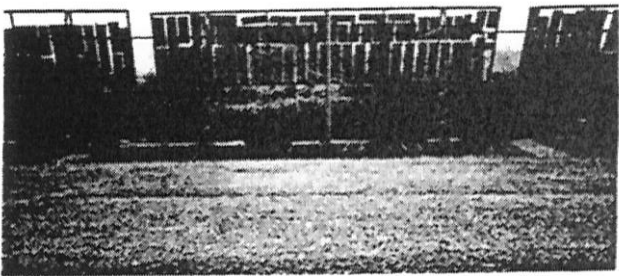


Fig. 3 Photograph of outdoor exposure racks at INTRON laboratories.

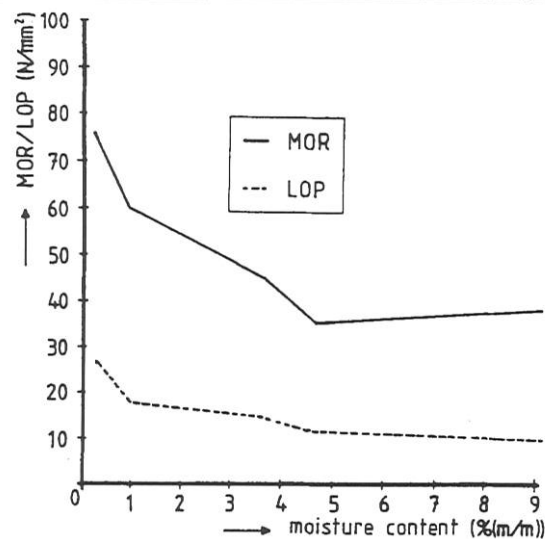


Fig. 4 Influence of the moisture content on the modulus of rupture (MOR) and limit of proportionality (LOP).

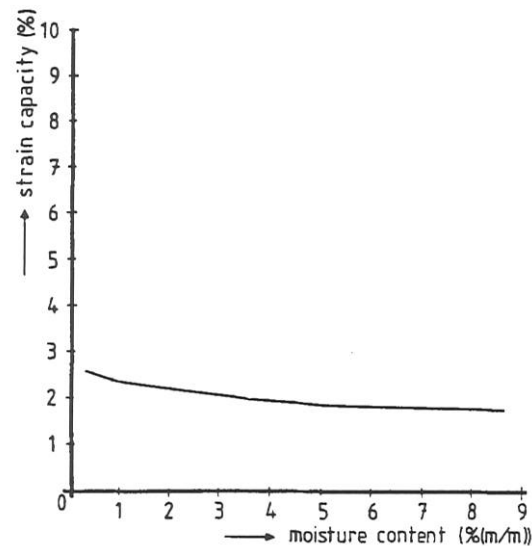


Fig. 5 Influence of the moisture content on the strain capacity.

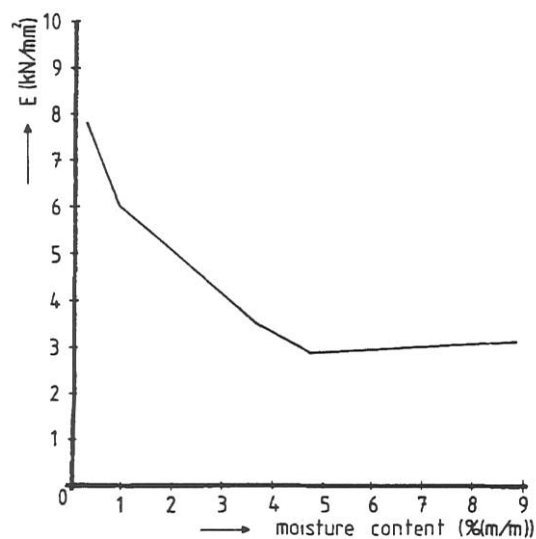


Fig. 6 Influence of the moisture content on the modulus of elasticity.

Table 3 Results of four-point bending tests after underwater exposure at 20 °C for 6 months and testing under different conditions

Material property	Wet-immersed	Subsequently conditioned at 20 °C/65% RH for 1 week	Subsequently dried
MOR (N mm ⁻²)	38	61	65
LOP (N mm ⁻²)	13	21	23
ϵ_{MOR} (%)	1.9	2.0	2.0
Moisture content (%)	15.9	1.0	±0.1
Dry density (kg m ⁻³)	1450	1460	1460

these racks under an inclination of 45° facing south-west. At regular intervals the moisture content of these gypsum panels was measured. The moisture contents, measured over a period of approximately 6 months, varied between approximately 0% and 3%.

Fig. 4 shows the influence of the moisture content on the modulus of rupture (MOR) and limit of proportionality (LOP). Figs 5 and 6 show respectively the effects on strain capacity and modulus of elasticity, both in bending. Obviously the effect of moisture is substantial. For instance, for outdoor exposure as a cladding panel a decrease in modulus of rupture of 30% relative to dry PGRG is not unlikely. When the material is in continuous contact with water further decreases have to be taken into account. However, even at high moisture contents up to 9% the material is still quite strong, with flexural strengths of approximately 35 N mm⁻². The decrease in strength when wetted appears to be recoverable. Table 3 shows results for samples which were immersed in water at 20 °C for 6 months.

3.2 Creep and fatigue

3.2.1 Creep

Creep tests were performed with four-point bending at 21 °C and 55% RH, and 21 °C and >95% RH. The stresses applied were respectively 0.4 σ_{LOP} , 1.0 σ_{LOP} and $\sigma_{LOP} + (\sigma_{MOR} - \sigma_{LOP})/4$, in which σ_{LOP} is the stress at the limit of proportionality, as shown in Fig. 1. For the tested samples this meant 7, 17 and 30 N mm⁻² (MPa) for 21 °C, 55% RH, and 4, 10 and 15 N mm⁻² (MPa) for 21 °C, >95% RH.

The creep curves after 116 days are shown in Figs 7 and 8. Creep coefficients are given in Table 4. Extrapolation to one year of the results obtained from samples tested under dry conditions (21 °C, 55% RH) gives values of 1.5 and 1.8 for 0.4 σ_{LOP} and 1.0 σ_{LOP} respectively (from the literature, similar creep coefficients are known for GRC at the same stress level relative to σ_{LOP} , respectively 2 and 1.7 for GRC and PGRG). The results for wet-tested samples at 0.4 σ_{LOP} appear to be similar to those obtained under dry conditions. For higher stress levels the creep appears to be larger.

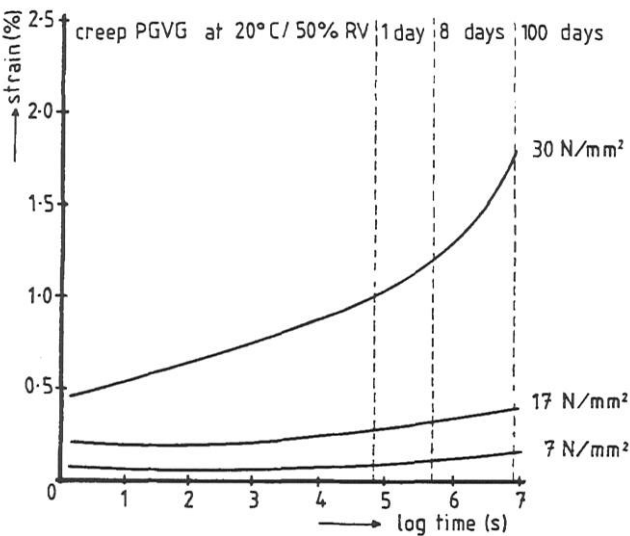


Fig. 7 Creep curves for PGRG stored at 21°C, 55% RH.

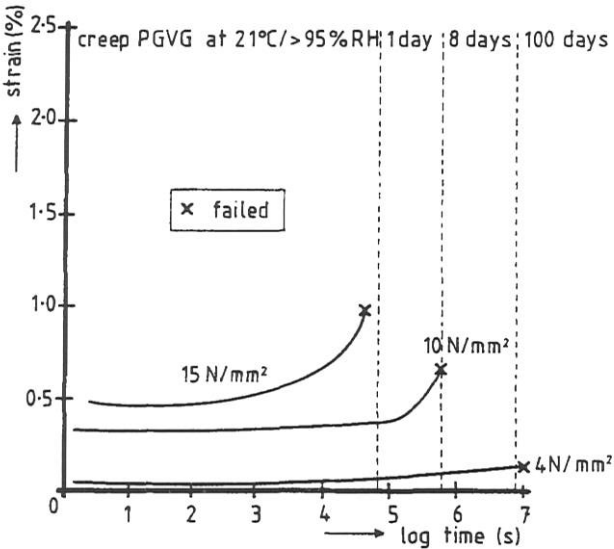


Fig. 8 Creep curves for PGRG stored at 21°C, >95% RH.

Table 4 Creep coefficients of Forton-Jesmonite at $t = 116$ days

Material and test conditions	Stress level		
	$0.4\sigma_{LOP}$	σ_{LOP}	$\sigma_{LOP} + (\sigma_{MOR} - \sigma_{LOP})/4$
PGRG 21°C, 55% RH	1.5	1.8	2.6
PGRG 21°C, >95% RH	1.0	Fractured ^a	Fractured ^a

^a Fractured due to large displacement.

3.2.2 Fatigue resistance

The fatigue resistance was also determined in four-point bending tests. The measuring method is essentially the same as given earlier [4]. However, on the PGRG a loading amplitude was imposed instead of a strain amplitude. A sinusoidal load was applied. Fig. 9 shows a

photograph of the fatigue device. The ratio between the minimum and the maximum load (R) was 0.1; the frequency applied was 20 Hz. At higher frequencies the material was heated up unduly. The testing conditions were 20°C and 60% RH. The samples were three months

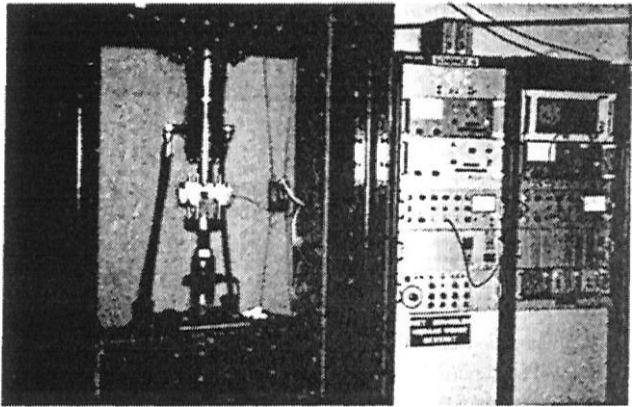


Fig. 9 Photograph of the fatigue device.

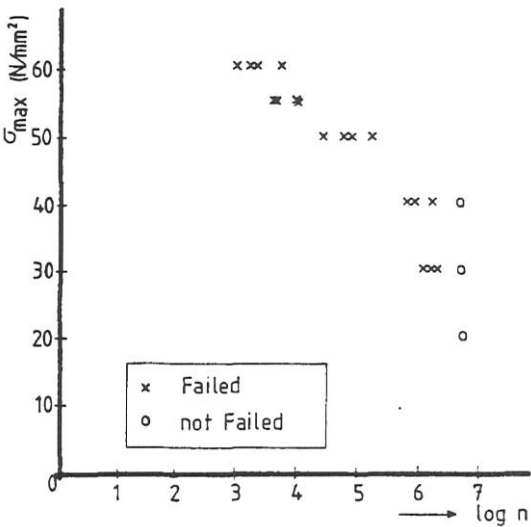


Fig. 10 Fatigue diagram of PGRG.

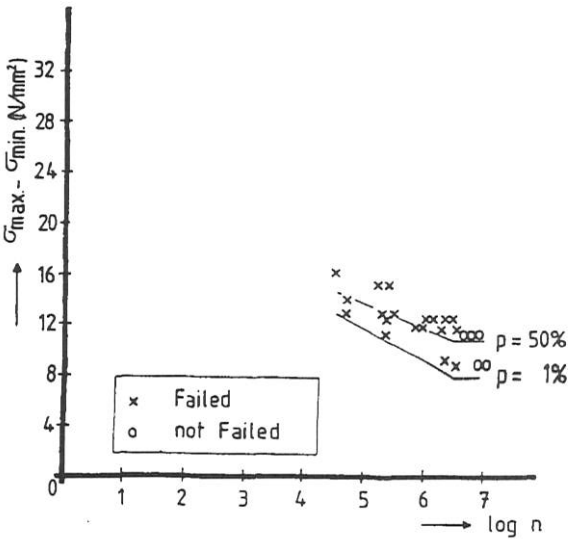


Fig. 11 Wöhler diagram of PGRG.

old at the start of testing. The fatigue cycling was ended if

- (a) the PGRG samples fractured,
- (b) deflection exceeded 20 mm, or
- (c) the number of cycles $\geq 10^6$.

The fatigue diagram for PGRG is given in Fig. 10. For the purpose of comparison, in Fig. 11 the Wöhler diagram is given for PGRC [4]. Obviously the fatigue resistance of PGRG is substantially higher than for PGRC at 20°C and 60% RH.

4. MOISTURE AND TEMPERATURE MOVEMENTS

4.1 Moisture movements

From experience with GRC it is known that stresses due to restrained moisture and temperature movements contribute substantially to the total loading. Especially for sandwich panels of the closed box type, these stresses are not negligible.

The moisture movement was determined by measuring the changes in dimension of PGRG sheets. The results are shown in Table 5. From dry to 95% RH at 20°C a total moisture expansion of about 0.75‰ is observed. For Western European climates, however, this movement is expected to be restricted to about 0.25‰ because strong drying conditions do not prevail. These are very acceptable values, certainly when taking into account the strain capacity of the PGRG.

Figs 12 and 13 show the respective mass change and

Table 5 Expansion of Forton-Jesmonite from dry to various moisture contents

Relative humidity at 20°C (%)	20	65	85	>95
Expansion (‰)	0.04	0.52	0.65	0.75

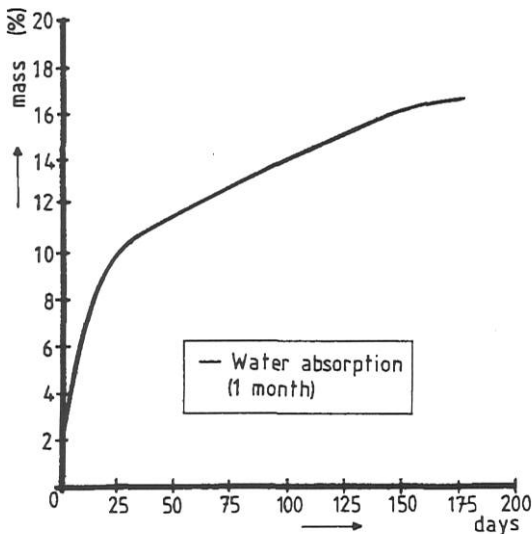


Fig. 12 Mass change due to water absorption when immersed in liquid water.

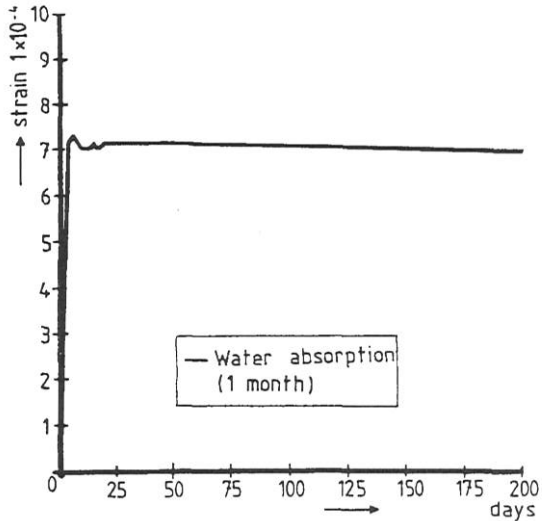


Fig. 13 Moisture movement due to water absorption when immersed in liquid water.

movement upon water absorption. The total moisture movement is substantially lower than for GRC and PGRC. The dimensional change occurs when the first few percentages of moisture are absorbed. Although moisture absorption continues, no significant dimensional change is measured any more. This behaviour confirms the quite different microstructure of gypsum compared with cement.

Related to moisture movements, the water diffusion resistance is also a measure of the speed of moisture transport. The water vapour diffusion resistance was determined according to German standard DIN 52615. The resistance was determined between 60% and 95% RH at 20°C. A value of 250 is found for the water vapour resistance number.

4.2 Thermal movements

The coefficient of thermal expansion was determined between -15 and 70 C on 5-week-old samples which were conditioned at 20 °C and 60% RH, and on fully dry samples. The coefficient α_L was $20 \times 10^{-6} \text{ } ^\circ\text{C}^{-1}$ for dry and $18 \times 10^{-6} \text{ } ^\circ\text{C}^{-1}$ for the 20°C and 60% RH samples.

5. DURABILITY

Knowledge of long-term performance of new materials is most important for designers. The most reliable method of establishing the durability of a material is to monitor its behaviour in practice. However, this is not very attractive for potential manufacturers. Accelerated ageing tests appear to be necessary but of course can never be a 100% guarantee for the actual behaviour. Since gypsum is not alkaline and contains no lime it is to be expected that the durability regarding the functioning of the E-glass fibres in the gypsum matrix will be good.

In the testing programme various accelerated tests were done. In one of these tests sheets of PGRG were exposed in a Weather-o-meter in cycles of wetting and drying,

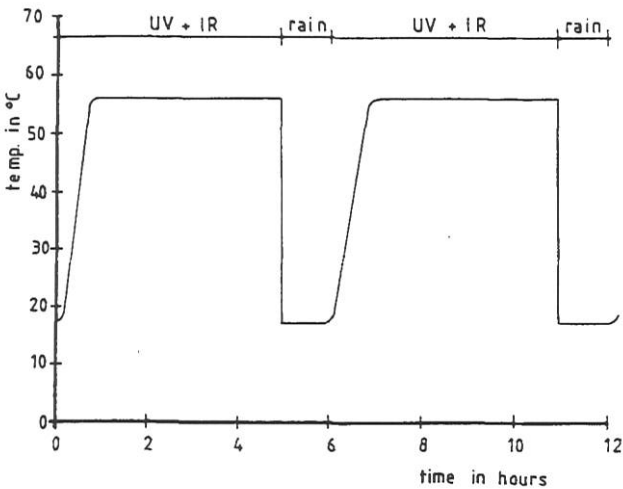


Fig. 14 Weather-o-meter cycles.

heating and cooling, and UV-light loading. Fig. 14 shows the testing conditions. Results after 2400 h or 400 cycles are given in Table 6. PGRG appears not to be affected by this exposure. Non-polymer-modified plain GRG completely disintegrates very fast during this test.

Another accelerated ageing test concerned a wet/dry cycling accelerated ageing test which is currently used for GRC. It consists of cycles of immersing for 24 h in water of 20°C followed by 24 h forced drying at a wind speed of 1 m s⁻¹ and a temperature of 70°C. Results are shown in Table 7.

PGRG sheets are also exposed on outdoor exposure racks at the INTRON laboratories, as discussed before. The properties will be tested at regular intervals.

To determine the frost salt resistance of PGRG the material was tested according to the RILEM CDC method. According to this test PGRG appears to be frost salt resistant [5].

Table 6 Results for dry material properties exposed to 400 Weather-o-meter cycles

Material property	After ageing	Reference sample
MOR (N mm ⁻²)	65.4	65.9
LOP (N mm ⁻²)	19.8	22.9
Dry density (kg m ⁻³)	1540	1650

Table 7 Results of dry material properties after 0, 13 and 50 cycles in CR.PAM ageing test

Material property	Cycles		
	0	13	50
MOR (N mm ⁻²)	75	67	65
LOP (N mm ⁻²)	25	24	27
ε _{MOR} (%)	2.5	2.6	2.7
Dry density (kg m ⁻³)	1500	1410	1323

6. MICROSTRUCTURE

When PGRG is compared with plain GRG the following differences are apparent:

- (i) The dispersion of glass fibre bundles appears to be more homogeneous. Obviously the rheology of the matrix is improved by the fine polymer particles which can fill up the interstices between the α-hemihydrate crystals.
- (ii) The fibre bundles are filled up partly with fine polymer particles. Unlike the coarser α-hemihydrate crystals, these polymer particles can fill up the inter-filament space of the bundles, the average distance between the filaments being 3 μm. The presence of the polymer is clear from Fig. 15, where the gypsum is etched away. The presence of the polymer particles in PGRG means a lasting improvement in the fibre–matrix bond, which substantially increases the material’s tensile strength and fracture toughness.
- (iii) The gypsum crystals in PGRG appear to be smaller than in GRG. Obviously the polymer influences hydration.
- (iv) When PGRG fractures only some of the fibres are pulled out. The other fibres fracture. In plain GRG almost all fibres are pulled out. From the fibres which are pulled out in PGRG it is likely that no real pull-out occurs but

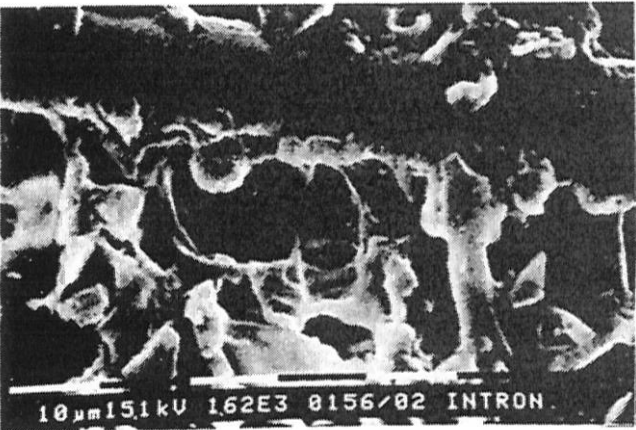
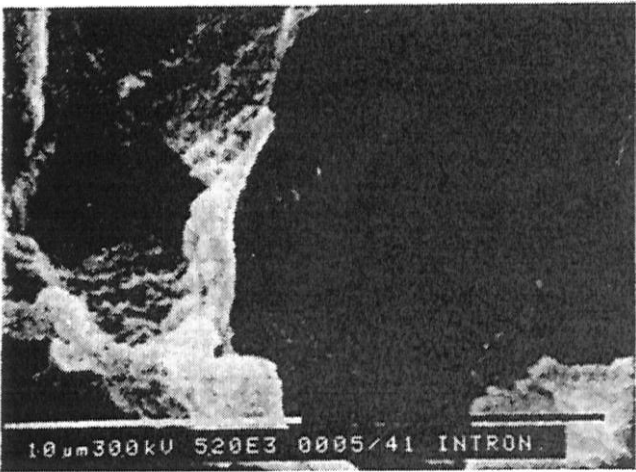


Fig. 15 Photographs of polymer structure of PGRG.

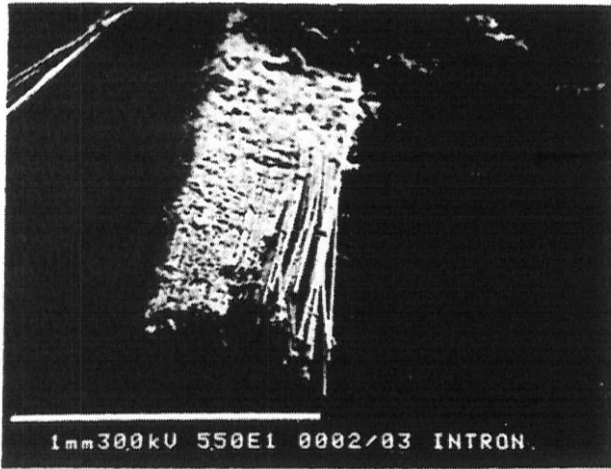


Fig. 16 Glass fibre strand pulled out.

rather than the matrix fails in shearing so that fragments of the composite, consisting of matrix surrounding filaments, is pulled out. Such a fragment is shown in Fig. 16.

7. FIRE RESISTANCE

Of course gypsum is known for its fire-resistant properties and this is certainly one of the reasons why it is very popular in building. However, polymers are indeed combustible materials. Provisional tests according to British Standard 476, Parts 6 and 7, provide the material with a Class O Building Regulation in the UK.

8. MANUFACTURING AND APPLICATION

8.1 Manufacturing

Manufacturing techniques for PGRG are spray-up, hand lay-up of fibre mats, and casting of premixes. For premixes with 10% of glass fibres, bending strengths of 35 N mm^{-2} (MPa) are achievable. Because of the high strength PGRG can be designed thin for many applications (though consideration should be given to stiffness).

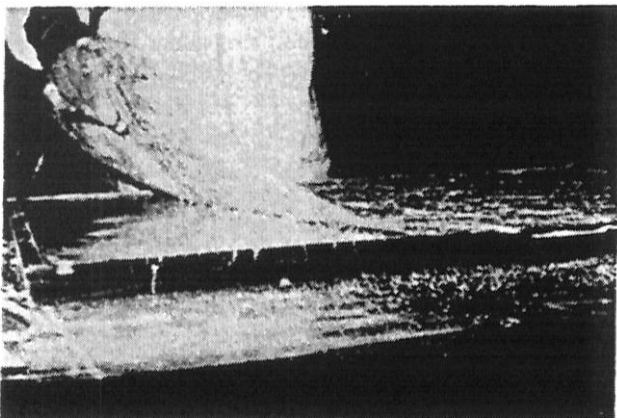


Fig. 17 Photograph of hand lay-up of mats.

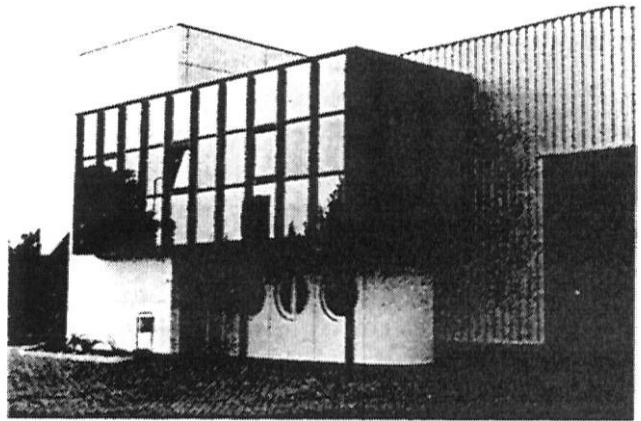


Fig. 18 Photograph of coping beams made for a building in The Netherlands.

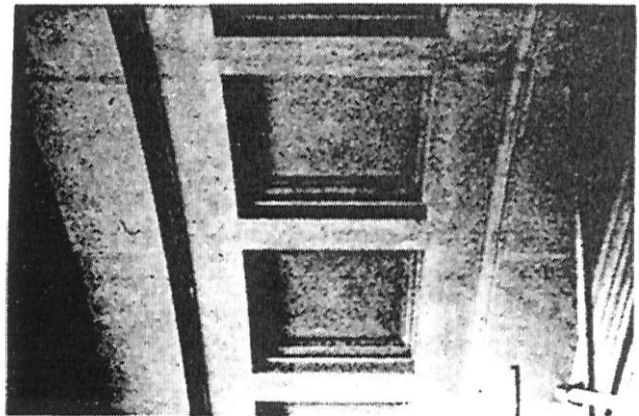


Fig. 19 Photograph of the use of PGRG in a railway station in London.

Spraying techniques are very sensitive with respect to the craftsmanship of the spray-up crew. When the material is produced thinner the negative effects of defects are increased. Therefore hand lay-up of mats will often be preferred, because in that case a homogeneous fibre distribution is better guaranteed. Fig. 17 shows a hand lay-up of PGRG in Forton's technical centre.

8.2 Applications

Gypsum up till now has only been used for indoor applications. Forton-Jesmonite PGRG is a new material. After intensive testing a variety of outdoor applications for this new polymer-modified gypsum are likely to be feasible. Examples are street furniture, flowerpots, architectural panels, shelters, window frames, etc. Fig. 18 shows coping beams made for a building in The Netherlands.

9. CONCLUSIONS

PGRG is a new, exciting composite. The test results have shown that polymer-modified glass fibre reinforced gypsum has excellent weatherability characteristics. A

variety of new outdoor applications for gypsum are likely to be possible now.

REFERENCES

1. Plas, C. van der, 'Properties of polymer-modified glass fibre reinforced gypsum' (Eigenschappen van polymeer-gemodificeerd glasvezelversterkt gips, PGVG), INTRON Report No. 89312.
2. RILEM Technical Committee 48 TFR, 'RILEM draft recommendations: testing methods for fibre reinforced cement-based composites', *Matér. Constr.*, **17**(102) (1984) 441-456.
3. 'Cladding panels of glass fibre reinforced cement' (Gevel-elementen van glasvezelversterkt cement) (STUPRE, 1988).
4. Bijen, J. and Jacobs, M., 'Properties of glass fibre reinforced polymer-modified cement', *Matér. Constr.*, **15**(89) (1982) 446-452.
5. Bijen, J. and Selst, R. van, 'Possibilities for increasing the weather resistance of gypsum products' (Mogelijkheden tot het verhogen van de weerbestandheid van rogips-produkten), INTRON Report No. 88271.

RESUME

Composite plâtre-polymère renforcé de fibres de verre

Le plâtre renforcé de fibres de verre, modifié par l'addition de polymère therm durcissable spécialement sélectionné et fabriqué, forme la base d'un nouveau matériau composite appelé PGRG, dont on a examiné certaines propriétés mécaniques: résistance à la flexion, à la traction et performance à long terme sous charge constante et charge de fatigue. On a déterminé l'influence de l'humidité et de la température sur les propriétés mécaniques. On a également

étudié l'équilibre de la teneur en eau à différentes humidités relatives, la teneur en eau en exposition naturelle, le coefficient d'expansion linéaire et la microstructure. On a aussi examiné la durabilité dans des conditions de vieillissement accéléré et l'exposition à l'atmosphère. Les résultats ont montré que les propriétés mécaniques du composite sont bonnes et que, à la différence du plâtre non traité, il peut résister au climat d'Europe Occidentale. Ceci permet d'envisager maintenant pour le plâtre diverses applications en ouvrages extérieurs. Le matériau a déjà été utilisé avec succès pour ce type d'applications en Grande-Bretagne, aux Pays-Bas et au Moyen-Orient.

Product name	Mowilith DHS S1	EUGB/EN
MSDS number	85163	Revision Date Feb.09.2015
Revision Number	3.01***	Issuing date May.23.2015***

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Product name
Mowilith DHS S1

Product Grade(s):
Perstorp***

REACH Registration Number
This product is a mixture and therefore not directly subject of the registration requirements under REACH.

1.2. Relevant identified uses of the substance or mixture and uses advised against

Identified uses
Industrial use

1.3. Details of the supplier of the safety data sheet
Celanese Emulsions Norden AB
Box 30
S - 284 21 Perstorp***

SDS Contact (email of responsible person)
HazCom@celanese.com***

1.4. Emergency telephone number
CHEMTREC: +1 703 527 3887 (Collect calls accepted)

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Classification according to Regulation 1272/2008/EC (CLP)
Not a hazardous substance or preparation according to Regulation 1272/2008 (CLP)

2.2. Label elements

EC Hazards
EUH210 - Safety data sheet available on request
EUH208 - Contains 1,2-Benzisothiazol-3(2H)-one; 2-Methyl-2H-isothiazol-3-one;
Mixture of: 5-Chloro-2-methyl-4-isothiazolin-3-one [EC No. 247-500-7] and 2-Methyl-2H -isothiazol-3-one [EC No. 220-239-6] (3:1)***. May produce an allergic reaction.***

2.3 Other Hazards
The mixture does not meet the criteria for PBT / vPvB according to REACH, Annex XIII***

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Statements of hazard	Frequent contact can lead to skin and eye irritation, especially if product is allowed to dry out Observe the usual precautions when handling chemicals.
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SECTION 3: Composition/information on ingredients

Chemical characterization Water-borne polymer emulsion. Basis: Vinyl acetate plasticizer-free

3.1. Substances	not applicable
3.2. Mixtures	see Chemical characterization

Components	CAS-No	EC-No.	Identification Number	Percent %
1,2-Benzisothiazol-3(2H)-one	2634-33-5	220-120-9***	613-088-00-6***	0.0152
Mixture of: 5-Chloro-2-methyl-4-isothiazolin-3-one [EC No. 247-500-7] and 2-Methyl-2H -isothiazol-3-one [EC No. 220-239-6] (3:1)	55965-84-9	247-500-7 + 220-239-6	613-167-00-5	0.0014
2-Methyl-2H-isothiazol-3-one	2682-20-4	220-239-6***		0.0152

Components	1272/2008/EC (CLP)	Hazard Statements
1,2-Benzisothiazol-3(2H)-one	Acute oral toxicity - Category 4 Skin corrosion / irritation - Category 2 Serious eye damage / eye irritation - Category 1 Skin sensitization - Category 1 Acute aquatic toxicity - Category 1 Chronic aquatic toxicity - Category 2	H302 H315 H318 H317 H400 H411
Mixture of: 5-Chloro-2-methyl-4-isothiazolin-3-one [EC No. 247-500-7] and 2-Methyl-2H -isothiazol-3-one [EC No. 220-239-6] (3:1)	Acute inhalation toxicity - Category 3 Acute dermal toxicity - Category 3 Acute oral toxicity - Category 3 Skin corrosion / irritation - Category 1B Acute aquatic toxicity - Category 1 Chronic aquatic toxicity - Category 1 Skin sensitization - Category 1A	H331 H311 H301 H314 H400 H410 H317
2-Methyl-2H-isothiazol-3-one	Acute oral toxicity - Category 3 Acute dermal toxicity - Category 3 Acute inhalation toxicity - Category 2 Skin corrosion / irritation - Category 1B Acute aquatic toxicity - Category 1 Skin sensitization - Category 1 Serious eye damage / eye irritation - Category 1 STOT SE - Category 3 Chronic aquatic toxicity - Category 2	H301 H311 H330 H314 H400 H317 H318 H335 H411

SECTION 4: First aid measures

Product name	Mowilith DHS S1	EUGB/EN
MSDS number	85163	Revision Date Feb.09.2015
Revision Number	3.01***	Issuing date May.23.2015***

SECTION 4: First aid measures

4.1. Description of first aid measures

General Information	Remove contaminated, soaked clothing immediately and dispose of safely.
Inhalation	Move to fresh air. If symptoms persist, call a physician.
Skin	Wash off with soap and water. If symptoms persist, call a physician.
Eyes	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Call a physician immediately.
Ingestion	If swallowed, seek medical advice immediately and show this container or label. If conscious, drink plenty of water. Do not induce vomiting without medical advice.

4.2. Most important symptoms and effects, both acute and delayed

Main symptoms	None known.
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4.3. Indication of any immediate medical attention and special treatment needed

Treat symptomatically.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media
Foam, Dry powder, Carbon dioxide (CO2), Water spray

Extinguishing media which must not be used for safety reasons
Do not use a solid water stream as it may scatter and spread fire.

5.2. Special hazards arising from the substance or mixture

Under conditions giving incomplete combustion, hazardous gases produced may consist of
Carbon monoxide
Carbon dioxide (CO2)
Combustion gases of organic materials must in principle be graded as inhalation poisons

5.3. Advice for firefighters

Special protective equipment for fire-fighters
Wear self contained breathing apparatus for fire fighting if necessary.

Environmental precautions
Dike and collect water used to fight fire..

Other Information
This is a water-based product and presents no particular fire or explosion hazard.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Contaminated surfaces will be extremely slippery. Avoid contact with the skin and the eyes.

6.2. Environmental precautions

Do not allow material to contaminate ground water system. Do not flush into surface water or sanitary sewer system.

Product name	Mowilith DHS S1		EUGB/EN
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6.3. Methods and material for containment and cleaning up

Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust). Keep in suitable, closed containers for disposal. Contaminated equipment (brushes, rags) must be cleaned immediately with water. Dispose of in accordance with local regulations.

6.4. Reference to other sections

Consult trained personnel. Consider the information for "Personal Protection" in chapter 8 of this Safety Data Sheet.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Hygiene measures

Wash hands before breaks and at the end of workday. When using, do not eat, drink or smoke Take off all contaminated clothing immediately Wash contaminated clothing before re-use

Advice on safe handling

Product may contain hazardous volatile ingredients which could accumulate in the unvented headspace of drums or containers. Open containers in ventilated area. Do not breathe vapor. During longer storage small amounts of carbon monoxide may form. To the best of our knowledge, no OEL (occupational exposure limit) is exceeded during the intended use. Containers/tanks may only be entered after thoroughly executed ventilation while considering national regulations and international standards for inspection of containers/tanks. In any case of doubt a measurement of the CO concentration is necessary.

Incompatible products

Materials that react with water

Protection - fire and explosion:

No special protective measures against fire required.

7.2. Conditions for safe storage, including any incompatibilities

Material storage

Protect from frost. To maintain product quality, do not store in heat or direct sunlight. Keep at temperatures between 5°C and 35°C (40°F and 95°F). Agitate before use.

Incompatible products

Materials that react with water

Technical measures/Storage conditions

Keep tightly closed in a dry and cool place. No special technical protective measures required.

7.3. Specific end use(s)

None known

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

EC Exposure Limit Values

No exposure limits established.

National occupational exposure limits

No exposure limits established

Product name	Mowilith DHS S1	EUGB/EN
MSDS number	85163	Revision Date Feb.09.2015
Revision Number	3.01***	Issuing date May.23.2015***

DNELs The product is exempt from REACH registration

PNECs The product is exempt from REACH registration

8.2. Exposure controls

Engineering measures Provide adequate ventilation. Where reasonably practicable this should be achieved by the use of local exhaust ventilation and good general extraction.

Personal protective equipment

General advice Avoid contact with skin and eyes.

Hygiene measures Wash hands before breaks and at the end of workday. When using, do not eat, drink or smoke Take off all contaminated clothing immediately Wash contaminated clothing before re-use

Eye protection safety glasses

Hand protection Chemicals resistant gloves

Suitable material nitrile rubber
Type Nitril (Company KCL) or comparable article;
or refer to glove manufacturer's recommendation

Evaluation according to EN 374: level 6
Material thickness approx. 0.1 / 0.4 mm
Break through time > 480 min

Environmental exposure controls
Do not discharge into the drains/surface waters/groundwater

Environmental Precautions
Should not be released into the environment

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance

Form liquid
Color white
Odor characteristic

Melting point/range ~ 0°C
Boiling point/range ~ 100°C
Density 0.95 - 1.1 g/ml @ 25°C
Method ISO 2811-3

pH 3.5 - 5.5
Method ISO 976

Viscosity 30000 - 60000 mPa*s
Method Brookfield Visc. RVT Sp. 7 / 20 r.p.m.

Product name	Mowilith DHS S1	EUGB/EN
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Vapor pressure	24 hPa @ 20°C
Water solubility	miscible

9.2. Other information The product was not tested for properties not listed on the MSDS..

SECTION 10: Stability and reactivity

10.1. Reactivity

Stable under recommended storage conditions.

10.2. Chemical Stability

No decomposition if stored and applied as directed.

10.3. Possibility of hazardous reactions

No hazards to be especially mentioned.

10.4. Conditions to avoid

Do not freeze.

10.5. Incompatible Materials

Materials that react with water

10.6. Hazardous decomposition products

No decomposition if stored and applied as directed

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute Toxicity:

LD50/oral/rat > 5000 mg/kg
Method: EC 440/2008, B.1 (corresponding to OECD 401)

Skin Irritation:

non-irritant
Method: EC 440/2008, B.4 (corresponding to OECD 404)
Species: rabbit

Eye irritation:

non-irritant
Method: EC 440/2008, B.5 (corresponding to OECD 405)
Species: rabbit eye

The toxicological data given are determined by analogy.

SECTION 12: Ecological information

Biodegradation:

Method: > 80 %
Zahn-Wellens-Test OECD 302 B

Toxicity to bacteria

Method: EC0: 1000 mg/l
OECD 209

Chemical Oxygen Demand (COD)

Method: 800 mg/g
calculated

Acute fish toxicity

LC50: > 500 mg/l

Product name	Mowilith DHS S1	EUGB/EN
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Durations: (hours)	96 h
Method:	OECD 203
Species:	zebra fish

Ecological data are determined by analogy.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Product information	Disposal required in compliance with all waste management related state and local regulations. The choice of the appropriate method of disposal depends on the product composition by the time of disposal as well as the local statutes and possibilities for disposal. Diluted solution may be introduced into a biological purification plant, with permission of the responsible authorities.
Uncleaned empty packaging	Contaminated packaging should be emptied as far as possible and after appropriate cleansing may be taken for reuse. Regulations concerning reuse or disposal of used packaging materials must be observed..
European Waste Catalogue	Allocation of a waste code number, according to the European Waste Catalogue (EWC), should be carried out in agreement with the regional waste disposal company.

SECTION 14: Transport information

ADR/RID	Not regulated
ADN	Not regulated
ICAO/IATA	Not restricted
IMDG	Not regulated

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

Water Hazard Class (WGK):	
WGK Class	1
WGK Reg. No.	662
WGK Source	Classification according to VwVwS, Annex 1 or 2

15.2 Chemical Safety Assessment
Chemical Safety Assessment (CSA) is not required

SECTION 16: Other information

Product name	Mowilith DHS S1	EUGB/EN
MSDS number	85163	Revision Date Feb.09.2015
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SECTION 16: Other information

For further information, see:

For more information, consult the Technical Data Sheet (www.celanese-emulsions.com).

Other Information:

- Traces of residual monomers can be found in the product:
- Vinyl acetate

Changes against the previous version are marked by ***

Training advice

Make sure that employees are aware of the hazards / risks as detailed on this Safety Data Sheet.

Sources of key data used to compile the datasheet

Information contained in this safety data sheet is based on Celanese owned data and public sources deemed valid or acceptable.. The absence of data elements required by ANSI or 1907/2006/EC indicates that no data meeting these requirements is available..

Further information

This information is based on our present state of knowledge. It shall describe our products regarding safety requirements and shall not be construed as a guarantee or statement of condition and/or quality.

Abbreviation and Acronym:

ADR = Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)

CAS = Chemical Abstracts Service (division of the American Chemical Society)

CLP = Classification, Labelling and Packaging

DNEL = Derived No Effect Level

EINECS = European Inventory of Existing Commercial Chemical Substances

GHS = Globally Harmonized System of Classification and Labelling of Chemicals

IATA = International Air Transport Association

IBC Code = International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IMO)

ICAO = International Civil Aviation Organization

IMDG = International Maritime Code for Dangerous Goods

LC50 = Lethal Concentration

LD50 = Lethal Dose

LOAEC = Low Observed Adverse Effect Concentration

LOAEL = Low Observed Adverse Effect Level

LOEL = Low Observed Effect Level

MEST = Mouse Ear Swelling Test

NOAEC = No Observed Adverse Effect Concentration

NOAEL = No Observed Adverse Effect Level

NOEC = No Observed Effect Concentration

NOEL = No Observed Effect Level

PBT = Persistent, Bioaccumulative and Toxic

PNEC = Predicted No Effect Concentration

RCR = Risk Characterization Ratio

RID = Règlement international concernant le transport des marchandises dangereuses par chemin de fer (Regulations Concerning the International Transport of Dangerous Goods by Rail)

R-Phrases = Risk Phrases

S-Phrases = Safety Phrases

Annex: Exposure Scenario(s)

Development of Exposure Scenario is not required

Product name	Mowilith DHS S1		EUGB/EN
MSDS number	85163	Revision Date	Feb.09.2015
Revision Number	3.01***	Issuing date	May.23.2015***

Product Name	Vinamul 8481	EMNA/EN
MSDS number	850017	Revision Date Jan.01.2014
Revision Number	0	Issuing date Apr.21.2014

1. Product and company identification

Product Name
Vinamul 8481

Celanese Ltd.
222 W. Las Colinas Blvd., Suite 900N
Irving, TX 75039
United States
Phone: 972 443 4000
Internet: www.celanese.com

Transportation emergency phone numbers:
In USA, call 800 424 9300
Outside USA, call 703 527 3887, collect calls accepted.

2. Hazards identification

Emergency Overview

This product is considered non-hazardous under the OSHA Hazard Communication Standard (29CFR1910.1200)

Product Description

Appearance	
Form	liquid
Odor	sweet
Color	white

Potential health effects

Routes of exposure Skin, eyes, inhalation.

Immediate effects

Skin	Prolonged or repeated contact may dry skin and cause irritation.
Eyes	May cause eye irritation
Inhalation	May cause respiratory tract irritation.

3. Composition/information on ingredients

Components	CAS-No	Percent %
Vinyl acetate polymer		54 - 56
Water	7732-18-5	44 - 46

Product Name Vinamul 8481
MSDS number 850017
Revision Number 0

EMNA/EN
Revision Date Jan.01.2014
Issuing date Apr.21.2014

4. First aid measures

General Information

Remove contaminated, soaked clothing immediately and dispose of safely.

Skin

Wash off with soap and water. If symptoms persist, call a physician.

Eyes

Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Call a physician immediately.

Inhalation

Move to fresh air. If symptoms persist, call a physician.

Ingestion

If swallowed, seek medical advice immediately and show this container or label. If conscious, drink plenty of water. Do not induce vomiting without medical advice.

5. Fire-fighting measures

Suitable extinguishing media

Foam, Dry powder, Carbon dioxide (CO₂), Water spray

Extinguishing media which must not be used for safety reasons

Do not use a solid water stream as it may scatter and spread fire.

Special exposure hazards arising from the substance or preparation itself, its combustion products, or released gases

Under conditions giving incomplete combustion, hazardous gases produced may consist of

Carbon monoxide

Carbon dioxide (CO₂)

Combustion gases of organic materials must in principle be graded as inhalation poisons

Special protective equipment for fire-fighters

Wear self contained breathing apparatus for fire fighting if necessary.

Environmental precautions

Dike and collect water used to fight fire.

Other Information

This is a water-based product and presents no particular fire or explosion hazard

6. Accidental release measures

Personal precautions

Contaminated surfaces will be extremely slippery. Avoid contact with the skin and the eyes.

Product Name	Vinamul 8481	EMNA/EN
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Environmental precautions
Do not allow material to contaminate ground water system. Do not flush into surface water or sanitary sewer system.

Methods for cleaning up
Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust). Keep in suitable, closed containers for disposal. Contaminated equipment (brushes, rags) must be cleaned immediately with water. Dispose of in accordance with local regulations.

7. Handling and storage

Advice on safe handling
Product may contain hazardous volatile ingredients which could accumulate in the unvented headspace of drums or containers. Open containers in ventilated area. Do not breathe vapor. During longer storage small amounts of carbon monoxide may form. To the best of our knowledge, no OEL (occupational exposure limit) is exceeded during the intended use. Containers/tanks may only be entered after thoroughly executed ventilation while considering national regulations and international standards for inspection of containers/tanks. In any case of doubt a measurement of the CO concentration is necessary.

Protection - fire and explosion:
No special protective measures against fire required.

Technical measures/Storage conditions
Keep tightly closed in a dry and cool place. No special technical protective measures required.

Material storage
Protect from frost. To maintain product quality, do not store in heat or direct sunlight. Keep at temperatures between 5 and 35°C (40°F and 95°F). Agitate before use. Keep tightly closed in a dry and cool place.

Incompatible products
Materials that react with water

8. Exposure controls / personal protection

OSHA Exposure Limits

ACGIH Exposure Limits
No exposure limits established.

Mexico National Exposure Limits

Exposure controls

Engineering measures
Provide adequate ventilation. Where reasonably practicable this should be achieved by the use of local exhaust ventilation and good general extraction.

Product Name	Vinamul 8481	EMNA/EN
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Protective equipment
A safety shower and eyebath should be readily available.

General advice
Avoid contact with skin and eyes.

Skin protection:
Wear impervious clothing and gloves when there is a reasonable chance for skin contact..

Eye/face protection:
safety glasses with side-shields.

9. Physical and chemical properties

Appearance	
Form	liquid
Color	white
Odor	sweet.
Boiling Point	100 °C (212°F)
Bulk Density	9 lbs/gal
pH	4.0 - 5.0
Method	ISO 976
Viscosity	<200 cPs
Specific Gravity	1.0804
Vapor pressure	24 hPa @ 20°C
Water solubility	miscible

10. Stability and reactivity

Chemical stability
Stable under recommended storage conditions

Conditions to avoid
Do not freeze

Incompatible Materials
Materials that react with water

Possibility of hazardous reactions
No hazards to be especially mentioned.

11. Toxicological information

Observe the usual hygienic measures for handling chemicals. Toxicological data are not available.

12. Ecological Information

Product Name	Vinamul 8481	EMNA/EN
MSDS number	850017	Revision Date Jan.01.2014
Revision Number	0	Issuing date Apr.21.2014

12. Ecological Information

Ecotoxicological data are not available. According to experience, the material has no harmful effect on the environment.

13. Disposal considerations

Disposal considerations
Dispose of spilled material in accordance with state and local regulations for waste that is non-hazardous by Federal definition. Note that this information applies to the material as manufactured; processing, use, or contamination may make this information inappropriate, inaccurate, or incomplete.

Note that this handling and disposal information may also apply to empty containers, liners and rinsate. State or local regulations or restrictions are complex and may differ from federal regulations. This information is intended as an aid to proper handling and disposal; the final responsibility for handling and disposal is with the owner of the waste.

14. Transport information

US Department of Transportation Not regulated

ICAO/IATA Not restricted

IMDG Not regulated

15. Regulatory Information

US State Regulations
none

U.S. FEDERAL REGULATIONS

TSCA Inventory
This product complies with the U.S. Toxic Substances Control Act (TSCA).

SARA 313 Chemicals
Contains no substances at or above the reporting threshold under Section 313.

CANADIAN REGULATIONS

WHMIS Classification:
Not a WHMIS controlled product.

All components are listed on the Canadian Domestic Substance List (DSL)

Product Name	Vinamul 8481	EMNA/EN
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16. Other information

Prepared By
Product Stewardship Department
Celanese

For more information, consult the Technical Data Sheet (www.celanese-emulsions.com) For more information, other material safety data sheets or technical data sheets please consult the Celanese homepage (www.celanese.com)

Sources of key data used to compile the datasheet
Information contained in this safety data sheet is based on Celanese owned data and public sources deemed valid or acceptable.. The absence of data elements required by ANSI or 1907/2006/EC indicates that no data meeting these requirements is available..

Other Information:
Traces of residual monomers can be found in the product:
Vinyl acetate
Changes against the previous version are marked by ***

For industrial use only. The information contained herein is accurate to the best of our knowledge. We do not suggest or guarantee that any hazards listed herein are the only ones which exist. Celanese makes no warranty of any kind, express or implied, concerning the safe use of this material in your process or in combination with other substances. Effects can be aggravated by other materials and/or this material may aggravate or add to the effects of other materials. This material may be released from gas, liquid, or solid materials made directly or indirectly from it. User has the sole responsibility to determine the suitability of the materials for any use and the manner of use contemplated. User must meet all applicable safety and health standards. Material safety data sheets are provided on the Internet by Celanese as a service to its customers. Possession of an Internet MSDS does not indicate that the possessor of the MSDS was a purchaser or user of the subject product.

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