International Solid Waste Association (ISWA) Specialised Conference
"MSW: Management Systems and Technical Solutions"

28-29 May 2013, Russia, Moscow, IEC "Crocus Expo"

Post Conference review

International Solid Waste Association (ISWA) Specialised Conference MSW: management systems and technical solutions was held between 28-29 May 2013 in Moscow, Russia. The scope of the event was to discuss innovative approaches in the field of municipal solid waste processing and disposal and to advise efficient solutions for emerging countries.

The two-day Conference was jointly organised by ISWA and SIBICO International and took place alongside the leading International Exhibition for Waste Management, Recycling, Renewable Energy and Environmental Technologies - WasteTech 2013 (www.waste-tech.ru).

NAUE Sponsored by the company **NAUE GmbH & Co. KG** the Conference has attracted more than 230 participants from a wide range of backgrounds (industry, academia, regional and national institutions, consulting bodies and private individuals) and from more than 26 different countries: Austria, Azerbaijan, Belarus, Belgium, Brazil, Denmark, Estonia, France, Germany, Greece, Hungary, Iran, Israel, Kazakhstan, Korea, Latvia, Lithuania, Malasia, Portugal, Russia, Saudi Arabia, Switzerland, the Netherlands, UK, Ukraine, USA.

80 oral presentations in four parallel sessions were presented in the scientific fields of waste management, collection, transportation, sorting and recycling, thermal treatment, waste-to-energy and environmentally friendly technologies for waste landfilling.

Derek Greedy, ISWA WG on Sanitary Landfills, UK**:** It was indeed a pleasure for me as Chair of the ISWA Landfill Working Group to attend what was a very well organised and vibrant conference. The sessions were all very well attended with much good debate which went on both inside and outside of the sessions. WasteTech exhibition was well attended and was ideal for networking. Although I am often critical of parallel sessions I think running just 2 did work for this conference and I would hope that you can keep to this for future events. Clearly you have a good formula for the event and to attract so many delegates from so many countries is commendable and speaks volumes.

Christian Stiglitz, ISWA, Vienna: I was quite impressed by the size and scope of the WasteTech exhibition 2013, and clearly the ISWA Special Conference was the right supplement to it. While visitors received plentiful information on technical products and services in the exhibition, the ISWA Conference gave a depth insight into the waste management challenges, theories, projects, and results from many districts of Russia as well as international regions and countries. The presentations were of high quality and I am sure that the visitors` expectations were not disappointed.

I found the attendance quite satisfactory and audience as well as speakers of high professional quality. I am sure that the idea of having a waste management conference as co-event to the WasteTech will have a promising future and such a forum can grow tremendously in size and content in the future.

Frans Willemse, ISWA WG on Collection and Transportation Technology, the Netherlands: I must say the quality of the presentations was good. Speakers from all over the world participated in the conference. The audience is very much interested in the developments in Europe and it was good to see that Russian universities are doing research on different subjects related to waste handling and processing. I am convinced that this conference is of great importance for the future in Russian waste management. A good combination is made with the WasteTech exhibition. Not only Russian companies were participating but also many companies from Europe and Asia.

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RECYCLING OF TEXTILE WASTES IN FIBRE-CEMENT COMPOSITES

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Keywords
cement; composites; compatibility; recycling; textile; waste.

Abstract
Changing wastes into raw materials is one of the most favoured options for waste management, as it diverts wastes from landfill and saves resources. Fibres, either vegetable (cellulosic) or synthetic, may be added to cement pastes in order improve the properties of concrete or mortar by reinforcement. At the same time, if our source of fibres is wastes, then such processes make ways for recycling. In this work we studied the compatibility of residues from the nonwoven textile industry with Portland cement, with the aim of manufacturing fibre-cement composites. The temperature of cement setting was monitored and when fibre or other materials were added to cement pastes. The textile waste from needling machines investigated here is not compatible with cement. The reason is ascribed to a higher cotton content (65%), which enables cation exchange to occur in cement suspensions, and that disturbs cement setting reactions. On the other hand, however, synthetic fibres do not seem to hinder cement setting.

INTRODUCTION

Turning wastes of a given industry, or activity, into raw materials for another industrial sector is one of the strategies to divert wastes from landfill. Advantages are economic and environmental, like the saving of resources, lower costs of waste disposal for the waste producer and lower costs of raw materials for the industry downstream.

The textile industry, which includes the sectors of spinning, weaving and clothing making, generates big amounts of wastes of a fibrous nature. According to EEA (European Environment Agency) [1], only in Portugal the combined leather and textile industries wastes amounted to 1,211 thousand tons in 2000. If it is true that such wastes have a high recycling potential by processing them down to fibre again, and then repeating the industrial steps that lead to the clothes we use, it is true also that some specific wastes have not found yet a recycling procedure. It is the case of short fibres of the nonwoven fabric industry.

The industrial sector of the nonwoven fabrics is actually a recycling industry. To have raw materials of lower cost such industry buys rags from the weaving and clothing sectors. The rags they receive are cut mechanically by a machine with knifes, then they are torn and, finally, they are shredded to fibre. After this, these fibres are spread into a mattress and enter into a needling machine. This mattress is pressed and the fast up-and-down movement of a transverse steel beam where numerous needles are attached makes the interlocking of the fibres, and this makes a thick fabric. The main waste that these companies produce, which is investigated in this work, is made by the fibres that drop from the needling machine. This waste is made of very short fibres, that are not suitable for spinning nor for nonwoven fabrics, and the companies have no way so far to recycle this residue.

Concrete technology makes a probable way to recycle short fibres. And this would only be feasible if fibre-added concrete presents improved properties for givens applications. Fibres, of any kind, either natural or synthetic, may improve concrete properties by reinforcement [2]. Fibres can lower the density of concrete to make light concrete. For example, wood-cement panels (where wood can be added in the form of fibres or chips) have a typical density of 1.5, hence about half of the density of a regular concrete. Also, wood-cement composites are easier to work, because they can be sawn with a common saw, shaped, drilled, nailed and sanded easily.

It has been possible to manufacture wood-cement particleboards to compete with gypsum boards, with the same average density (0.7) and with better bending and screw-withdrawal properties [3]. Corn cob particleboards have been proposed as a possible alternative material for thermal insulation [4, 5], and the same agricultural waste has been suggested as a sustainable aggregate for lightweight concrete manufacturing [6]. Also, the advantages of reinforcing cement-based coating mortars with the incorporation of textile threads waste have been assessed [7, 8].

When incorporating organic materials into concrete or cement pastes one problem may arise. Such materials may hinder cement setting reactions, by mechanisms that may involve the release of given chemical compounds [9], cation adsorption phenomena [10] or even factors related with particle size [11]. Some materials, like western larch (*Larix occidentalis*) wood, can be so highly interfering with cement setting that ultimately a product without physical integrity may be obtained.

In order to assess the feasibility of reinforcing concrete or manufacturing cement panels with textile wastes, and at the same time looking for a recycling technique, in the work presented here we have investigated the compatibility of waste fibres from the production of nonwoven fabrics. The method was based on the monitoring of cement setting by registering the temperature. The comparison of temperature profiles for several experimental conditions gave information on the extent of cement hardening and, hence, on the compatibility, and/or suitability, of recycling such wastes by incorporating them in cement composites.

MATERIALS AND METHODS

The fibre waste was provided by a Portuguese manufacturer of nonwoven fabrics. We were informed that this waste should contain about 60% of cotton, being the remaining mostly polyester. The cement was provided by a Portuguese cement producer. To have a strong exothermic setting, so that a temperature profile could be registered, it was used cement Portland Class I 42.5 R of CIMPOR. These materials were kept in plastic bags for about 3 months.

Fibre moisture content was measured by placing duplicate samples of it of about 15 g in weight each in an oven at 105 ± 3 ºC for an overnight period. Wet and dry weights were used to calculate moisture content.

The cotton percentage in the fibre waste was determined by adapting the Klason lignin method [12]. This method is used to analyse the content of lignin in wood or pulp, and is based on the total hydrolysis of polysaccharides by strong acid leaving the condensed lignin as solid residue. In our case, the cotton fraction of the waste is totally hydrolysed, leaving synthetic fibres as an insoluble residue. Cotton analysis was done in duplicate.

The apparatus for cement setting involved the use of a thermally isolated flask and a thermocouple that was connected to a data logger OMEGA OM-PLTC, which was linked to a desktop computer. Temperature data were acquired with software provided by the data logger manufacturer. Each 10 minutes, along 24 hours, a temperature value was registered.

Cement pastes were produced as a mixture of cement, water and fibre. For comparison purposes we have also included in the experiments small pieces (about 5 x 5 mm) of LDPE (low-density polyethylene) (100% synthetic plastic material) and cotton fibre (100% organic and natural material). In this case, the cotton we have applied is that one used by nonwoven fabric manufacturers for their products. It is a sub product of the cotton production and processing industry, known as “cotton seeds”, and it was not bleached.

Cement pastes were prepared by mixing 200 g of cement, and 70 g of water and 20 g of waste fibres to achieve a cement to fibre waste weight ratio of 10:1. This same ratio was applied when testing LDPE and “cotton seeds”. Calcium chloride ($CaCl_2$), a common cement setting accelerator, was used as cement-fibre compatibility enhancer, at a rate of 4% of cement.

Pastes were worked out for 5 min. They were then wrapped in aluminium foil and transferred to the thermo flask. The thermocouple wire was inserted in the paste and the remaining empty volume of the flask was filled with pieces of Styrofoam. The flask was then closed and the software for temperature data acquisition was activated.

RESULTS AND DISCUSSION

The stock of fibre residue had 0% moisture content, and no correction was needed when weighing fibre portions for cement pastes. The percentage of cotton in this waste was determined as 65%.

Figure 1 shows the average temperature profiles obtained with the conditions indicated before for cement setting. As shown by the pronounced decrease in the peak temperature (T_{max}) relatively to the neat cement, and by a lengthen in the time to reach that temperature (t_{max}), the fibre waste interferes considerably with the cement hardening. Such interference is so drastic that, even using $CaCl_2$ dissolved in the water for cement pastes, did not have a significant rise in T_{max}; only t_{max} was shortened because of $CaCl_2$, but not much.
LDPE, probably because it is an inert material (plastic), both in terms of chemical reactions and surface interaction, does not seem to hinder cement setting in a significant extent. On the other hand, the thermogram obtained with "cotton seeds" (100% cotton) shows basically that no heat was generated and, hence, cement did not set. This could be seen during the experiments by the total lack of integrity of the pastes after temperature recordings.
With such results we do not assign to the polyester fraction of the fibre waste the interference in the cement setting shown by the fibre waste. Conversely, we assign to the cotton component the origin of the hindrance in cement setting showed by the fibre residue. This may be due to any extractives that might have been are dissolved from cotton, as it was not bleached, or because of the adsorption of some cations present in cement suspensions, and that are involved in cement setting reactions, like calcium (Ca^{2+}), or both.
As suggestions for further research, if these results put forward that natural fibres interfere considerably with cement setting, as seen from the thermal behaviour of cement setting, it should be assess in what degree such effect is reflected in the properties of mortar and concrete, for example, by assessing mechanical and physical properties like compressive and flexure strength, workability, durability and permeability.
Another important conclusion is that synthetic fibres do not hinder cement setting. In this way, waste fibres made of 100% synthetic mixes can be applied for the reinforcement of concrete or mortar, or in the production of cement panels.

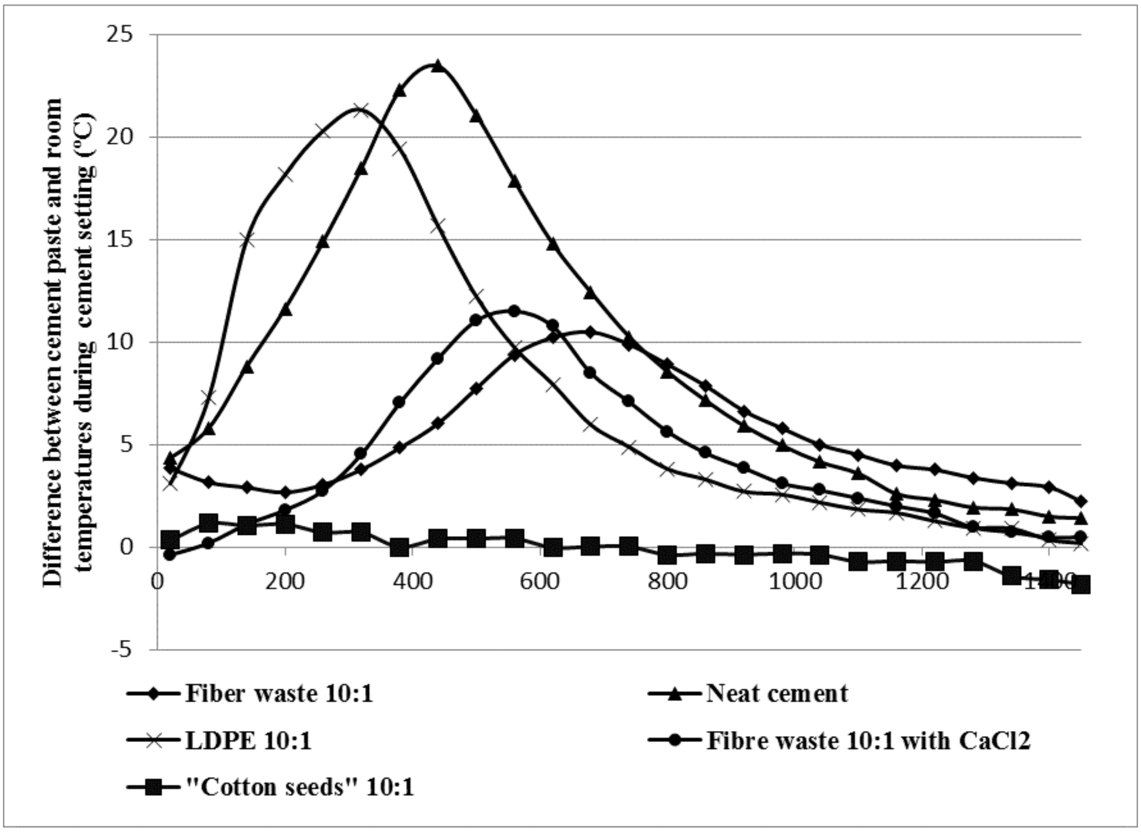

Figure 1 - Temperature profiles of cement setting obtained in the different conditions experimented.

ACKNOWLEDGEMENTS

Authors would like to acknowledge CIMPOR – Cimentos de Portugal, SGPS, S.A. for providing the cement for these experiments, and to PASTOFO – Pasta para Estofos, S.A. for providing the fibre waste.

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