**Use of TDF in Cement Production (TYRE DERIVED FUEL)**

**One among the most promising waste streams that can be used as alternative fuel in the production of cement is considered that of TDF from used tyres. Used tyres can be used in a number of different TDF forms during their feeding in the cement kilns. The blending of TDF in the process of cement manufacturing together with other traditional fuels, the so called co-processing, is an effort to provide the cement plants with the necessary quantities of energy and raw materials.**

**As an alternative fuel, TDF is mixed with primary fossil fuels to provide the required heat energy by rotary kilns that melt limestone and other raw materials for the production of cement.**

**On average, TDF can replace 5-25% of the heat energy requirements at a cement producing plant. In Europe, there are some cement plants burning as much as 80% of TDF.**

**Synthesis – characteristics – energy content**

**TDF contains quite a number of chemical elements in its composition (see composition of TDF in Table 1). Similar to fossil fuels such as coal, natural gas, oil, etc., TDF also contains various hydrocarbons. It should be pointed out that the TDF has more fuel value per unit weight than coal.**

**Table 1: Composition of TDF**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sr. No.** | **Material** | **Content %** |  |
| **1** | **RUBBER/ELASTOMER** | **45-48** |  |
| **2** | **CARBON BLACK & SILICA** | **21-23** |  |
| **3** | **METAL** | **15-25** |  |
| **4** | **TEXTILE** | **0-5** |  |
| **5** | **ZINC OXIDE** | **1-2** |  |
| **6** | **SULPHUR** | **.8-1.5** |  |
| **7** | **ADDITIVES & OTHERS** | **0-8** |  |

**(Source: M. Schneider; The use of wastes and industrial by-products in cement production; 8th International Seminar on Cement and Building Materials November 18 - 21, 2003, New Delhi, Adapted from Hylands and Shulman 2003)**

**The synthesis of TDF is made up of mainly three constituents, that is, carbon black, oil and steel. Its composition by weight dry is as in Table 2. Corresponding composition of coal and pet coke mix is quoted as well for comparison.**

**Table 2: Composition of TDF and comparison with coal-pet coke mix**

|  |  |  |
| --- | --- | --- |
|  | **MIX COAL+PETCOKE** | **TDF** |
| **C (% WT, DRY)** | **75.1**  | **87.0**  |
| **H (% WT, DRY)** | **4.2**  | **7.8**  |
| **N (% WT, DRY)** | **1.7**  | **0.3**  |
| **S (% WT, DRY)** | **3.0** | **0.8 -1.5** |
| **O (% WT, DRY)** |  **4.9**  | **1.9**  |
| **Fe (% WT, DRY)** |  **0** | **15.4**  |
| **H20 (% WT, DRY)** | **1.3** | **0.7**  |
| **ASH (% WT, DRY)** | **11.1** | **2.2**  |
| **L.H.V. (MJ/kg,DRY)** | **29.81** | **36.84** |

**(Source:Ursula Kääntee, Ron Zevenhoven, Rainer Backman, Mikko   Hupa;  CEMENT MANUFACTURING USING ALTERNATIVE FUELS AND THE ADVANTAGES OF )**

**Process Modelling**

**Used tyres are utilized in a number of different configurations soon as they have been characterised as waste. Most interesting among them for the cement industry is the Tyre Derived Fuel. They have a high calorific value. In particular, the energy content of TDF ranges from 7,200 to 8,300 Kcal/Kg according to various cases. The preceding value of energy content is comparable with high quality coal.  In Table 2, cites a comparison between a coal-pet coke mix versus TDF. The latter, has an increased calorific value by some 20% with respect to the former. It is apparent that at least from an energy point of view, TDF would be considered as an excellent substitute Or at least an ideal additive of primary fossil fuels.**

**Technological and Process Issues**

**The more energy efficient dry process cement kilns generally run at higher combustion temperatures and provide longer residence time and adequate oxygen. An excess air is provided to achieve complete combustion. Therefore, cement kilns typically run on the lower limits of excess air for good combustion due to the huge quantities of air required to be heated from ambient temperatures to 1,450 o C, to optimize on energy costs. The use of TDF can improve the combustion characteristics of high ash coal, especially the ignition performance and the peak weight loss compared with the separate burning of TDF and coal, which indicates that the co-combustion of TDF and low quality coal as fuel is feasible.**

**TDF CHIPS : Feeding cement kilns with TDF is in the “chip” form. These TDF chips are varying in dimensions. Their shape in most cases is of the square form with sides ranging from 2 by 2 centimetres and reaching even 15 by 15 centimetres. The use of chipped TDF as a secondary fuel in cement kilns has the advantage of the continuous feed rate and its precise regulation. Because of the inherent comfort of feed rate regulation the requirements for manual labour involved in handling the TDF chips is minimal.**

**One problematic issue of using TDF chips is that the wire in the bead and radial belts do not shear smoothly when tyres are chipped. This makes the chips hook on everything they come in contact with causing problems to points such as in the front loader, the trucks and other vehicles coming near the storage areas. Nevertheless, presence of the steel content might be seen as a an advantage in this specific TDF since, steel is required in the cement kilns for the production of cement itself.**

**The residues of TDF Chips (iron, steel, etc.) can be considered as alternative raw material in the production of clinker.**

**Environmental Aspects**

**The fact that TDFs are highly efficient energy producers and reduce the use of fossil fuels makes the case even more powerful. TDF typically has a sulphur content ranging from 0.5 to about 2.0%. This is less than or equal to most coals and pet coke fuels burnt in cement kilns. The hydrocarbons that make up the rubber in the TDF are of the same complexity and pose similar degree of difficulty to destroy than those present in coal. The steel in the bead and the radial belts constitute about 12% by weight.Cement plant operators must take carefully into account the presence of above constituents, when they formulate the raw meal. TDF as a fuel may also contain small amount of metals such as lead, cadmium and zinc. While this should not be a problem for burning in most cement kilns, the person responsible for the environmental impacts of TDF use, should evaluate the concentrations of above said constituents as well as any other metals in the raw meal and their subsequent presence in clinker and cement kiln dust, so as to ensure that the additional metals possibly added because of the use of TDF will not pose any problems.**

**The feed method of TDF in the cement kiln may influence the CO emission through the exhaust gases. If crumb or chipped TDFs are fed at a uniform rate then increased kiln exit oxygen is permissible or even a desirable kiln exit oxygen to be maintained. Similarly, kiln exit CO concentration can also be maintained at desirable levels by uniform rate supply of TDF.**

**Some plants may also experience changes in sulphur oxides (SOX) and/or nitric oxides (NOX) levels, depending on where and when the TD fuel is burned. Moreover, under the same conditions, changes in oxygen levels may be observed.**