Alternative solid fuel for cement kiln based in no special industrial solid waste

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Keywords: thermal valorization, no special industrial solid waste, cement kiln
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The annual production of non-special industrial solid waste (NSISW) represent a not insignificant portion of the total waste generated by Argentinian industries. These solid wastes are produced by different industries: food, cosmetics, pharmacy, textile, wood, between others. Typically, these waste streams were disposed in landfields without any previous treatment or separation process. Just 20 years ago, the thermal valorization of these type of wastes began to be explored. In particular, the NSISW are appropriate to replace part of the solid fuel used in cement kiln (Georgiopoulou, 2017). The high temperatures reached in cement kiln prevent the formation of dangerous compounds as dioxins and others. At present, the replacement of regular fuel by alternative ones produced from NSISW in some Argentinian cement kiln is closer to 5%. In this paper, the evolution of the processing of NSISW to obtain solid fuel for cement kiln is described, as an example of the development of an industry dedicated to the valorization of industrial solid waste.

Special liquid industrial wastes (SLIW) were the typical precursor for the elaboration of alternative fuels with high caloric power. The principal components included used automobile oil, exhausted catalysts for petroleum refining and tank bottoms (oil). With the improvement of the technology used in oil refining plants, the availability of this liquid wastes decreased. Besides, in Buenos Aires province (holding an important percentage of the country oil refining capacity), recent changes in legislation (OPDS, 2010) limited the treatment of used oil, deriving it to oil regeneration and prohibiting its use as fuel. Other factor that reduced the availability of these valuable liquid wastes was the emergence of landfarming with capacity to receive this type of wastes. For this reasons it was necessary to search for other waste streams that allows the formulation of new alternative fuels with high caloric value.

Around the year 2001 an alternative solid fuel was designed, including NSISW generated by the neighborhood factories. The critical parameters to consider when working with NSISW as fuel are: caloric value, moisture and chloride content. Other parameters to be considered are the content of metals and potential pollutants (as pesticides) than may prevent its incorporation to the fuel. These parameters depend on the source of NSISW, and should be equalized to obtain a fuel with the appropriate characteristics. Caloric value strongly depends on the main components of the solid waste and should be no less than 16736 KJ/Kg in the final product. Moisture have to be in the range 5 – 15 % to prevent self-ignition and an elevated heat consumption once in the cement kiln (Table 1). Chloride content has to be less than 0.4% to prevent NaCl incrustations in the chimney (Genon, 2008; Ma, 2010). Particle size and density are physical parameters that have to be controlled in order to produce a fuel suitable to feed the cement kiln.

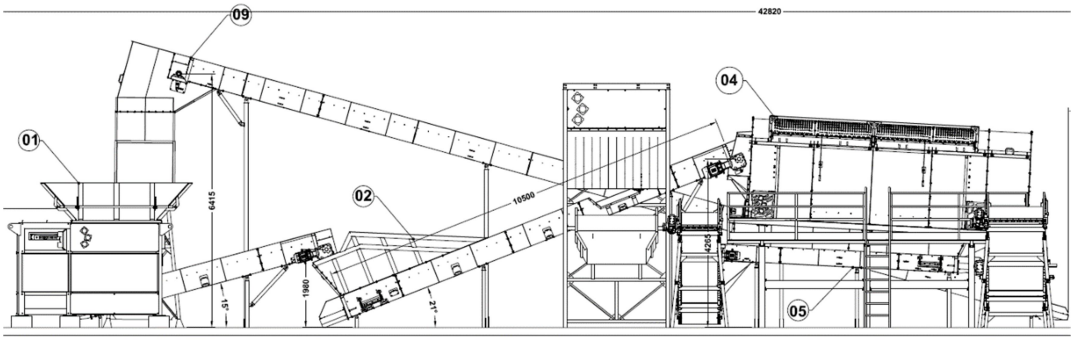
Table 1: Lower calorific value and moisture for different samples of NSISW

Alternative solid fuel	Lower calorific value range [KJ/Kg]	Moisture [%]
$NSISW_1$	23012	5
$NSISW_2$	18828	10
$NSISW_3$	16736	15

Operations involved to obtain a fuel precursor with adequate properties are: reduction of particle size, separation of components with different size, and mixing. To perform these operations a processing line was constructed, containing a crusher, rotating sieve (*trommel*) and two mixing drums (*mixers*), with a total capacity of 5 m^3/h (densities greater than 0,3 kg/m^3). These facilities allowed the realization of tests with different waste streams, analyzing its performance and the optimization of different process parameters as granulometry and humidity. This technology was functional for the preparation of the first sets of solid fuel precursor which, after properly mixing with SLIW to adjust density and caloric power, produced the first type of alternative solid fuel for cement kiln.

By the year 2013 a new processing line was installed, made up with the following equipment: feed hopper, pre-crusher, magnetic separator, *trommel* and recirculation belt. Processing capacity was 2 tn/h with a

recirculation close to 70-80 %. Recirculation was necessary to obtain the needed granulometry (Φ < 50 mm). Figure 1 shows a lateral view of the mentioned installation.



01: Primary crusher; 02-05-09: conveyor belts; 04: Trommel

Figure 1: Side view of the process line incorporated in 2013

Lately, due to an increment in the fuel demand by cement kiln, and to produce a solid fuel based only in NSISW, new processing lines were incorporated, containing: i) air separator; ii) conveyor belts; iii) shredder. These lines can be operated in line or independently one of the other, with high versatility. Figure 2 shows and scheme of the full plant for the processing of NSISW.

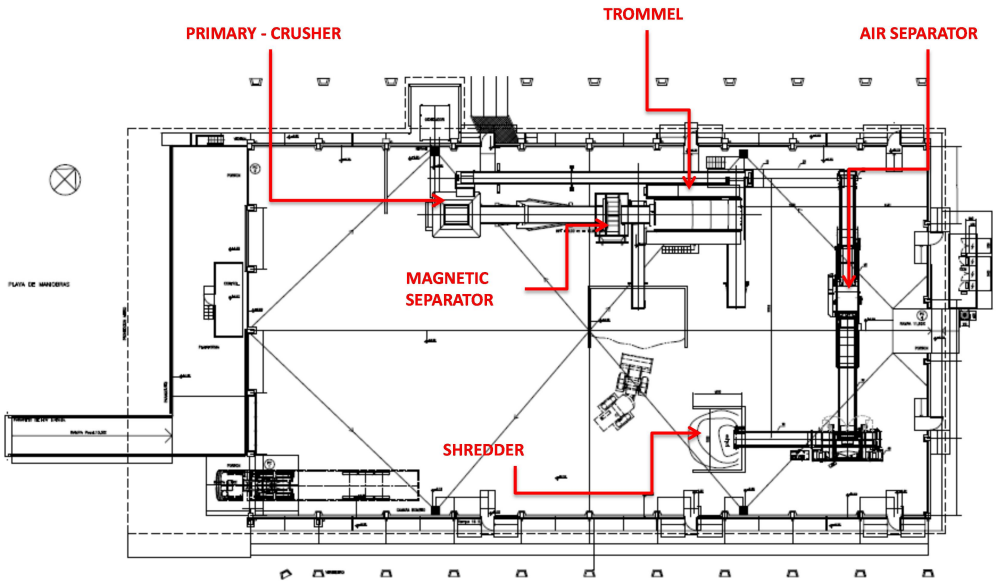


Figure 2: The floor plan of the two process lines

Processing capacity was increased to 10 tn/h, recirculation was notably reduced and final particle size was smaller (Φ < 30 mm) and more uniform than before.

NSISWs are an alternative for fossil fuel in cement kiln. At present 5% substitution was reached and it will increase to 8% in the next year.

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