



Guidelines for the implementation of the  
Circular Economy models.

## **FACTSHEET CC2**

**Construction: roads with WPFA based HRB binders**

Summary extracted from D7.3. August 2021 (M51)



New Market Niches For the Pulp and Paper Industry Waste based on Circular Economy Approaches



This project has received funding from the European Union's Horizon 2020 research and innovation Programme under grant agreement N° 730305

## Keywords


Guidelines	Construction material	Pulp & Paper Industry (PPI)	Circular Economy Model (CEM)	Fact sheet
assessment	requirement	standard	Waste	performance
Soil Cement	Stabilisation	Leaching	Binder	roads

The full deliverable can be found at the following DOI: [10.5281/zenodo.5874513](https://doi.org/10.5281/zenodo.5874513)

## Circular Model Guidelines CC2 Construction: roads with WPFA based HRB binders.

**CC2: Wastepaper Fly ash (WPFA) for Hydraulic Road Binders (HRBs) production:** CC2 is focused on Wastepaper Fly Ash (WPFA) based hydraulic road binder (HRB) production for soil stabilization in road construction sector. ACCIONA (Constructor) and SAICA (PPI waste valoriser) that generates the WPFA, cooperated in PAPERCHAIN to find an alternative and sustainable solution for the use of fly ash waste other than landfilling. In CC2 ash replaces standard binder (cement) typically employed in the stabilization of soils S-EST2, S-EST3 type layers (according to local standards PG3) in rural roads, and a soil-cement layer in highway. 3 Pilots successfully completed in Spain: a) unpaved rural road (Ejea de los Caballeros, Zaragoza), b) paved peri urban road (Villamayor de Gállego, Zaragoza); c) A31 highway (La Font de la Figuera, Valencia). UPC (University), and TECNALIA (Research Center) have supported CC2 in product design, and the technical and environmental performance monitoring. Process must be adapted to the characteristics of WPFA to avoid problems of low density, mixing-compaction and generation of dust when mixing on site (stabilized soils approach). WPFA quality monitoring is focused on its salts and heavy metals content and variability. CC2 CEM has a high replicability potential. A technical Conformity (TC) document for its certification as product in progress. Figure 1 shows the CC2 Circular Case in Spain, Figures 2-4 show the industrial scale pilot demonstration, and Tables 1 and 2 show the CC main items, Key factors and lessons learnt.

### CC2 WPFA based hydraulic road binders short Guidelines:

-  Circular Economy Models using waste paper fly ash (WPFA) derived from the energetic valorisation of paper waste use in hydraulic road binders as developed in PAPERCHAIN approach (CC2), are limited by its classification as "waste", its and lack of specific legal framework promoting WPFA use in hydraulic road binders production. Technical and environmental performance and workability according to usual nHRB binder elaboration procedures have been proven to be successful, with affordable process costs. Replicability potential of this CEM is considered of high potential across EU Ms.

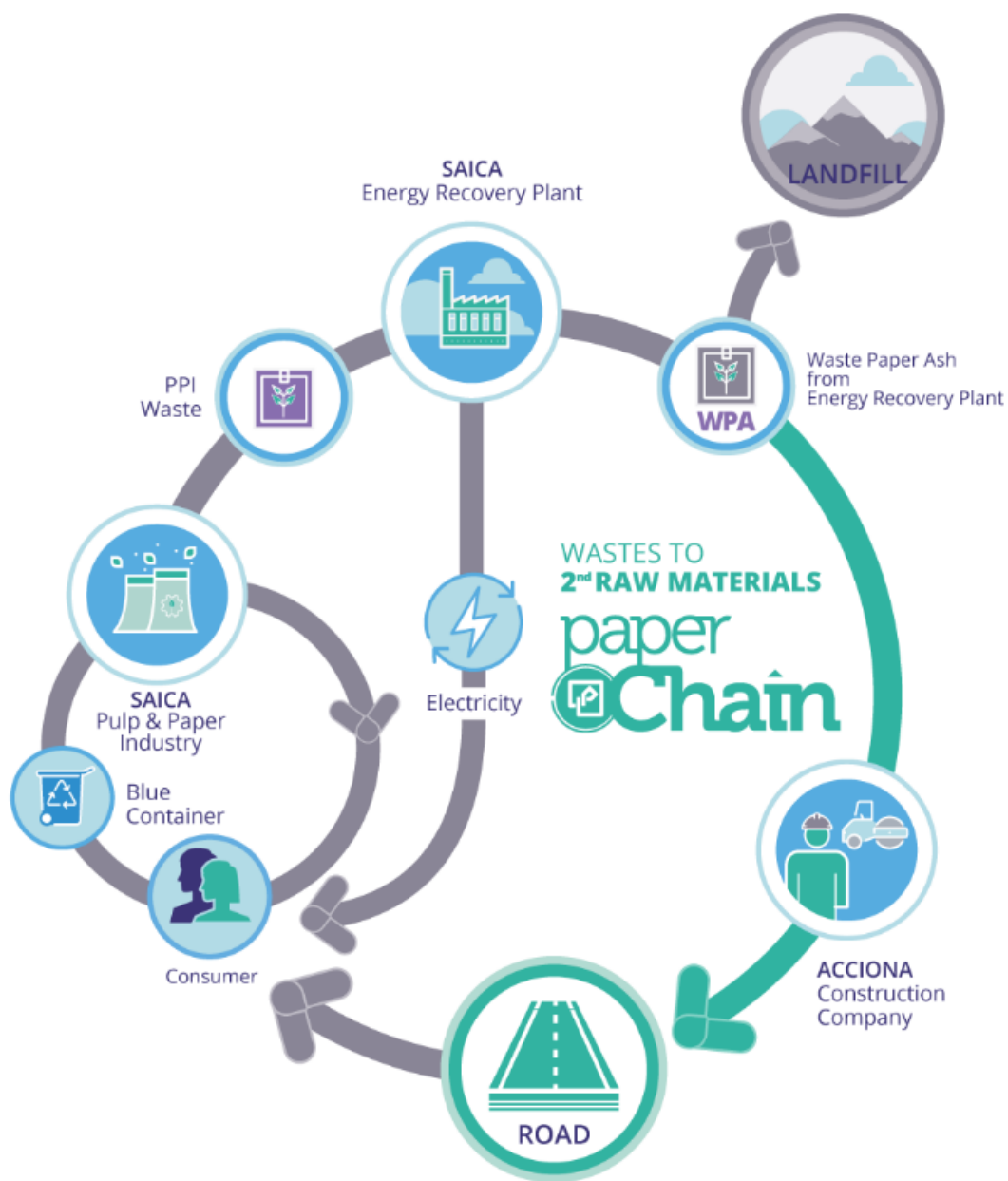


FIGURE 1 – CC2 CIRCULAR CASE (SPAIN). CONSTRUCTION OF ROAD LAYERS WITH WPA.



Figure 2 – Waste. WPFA derived from the incineration of recycling paper waste (SAICA).



FIGURE 3 – PROCESS: (UP) STABILIZING A SOIL WITH WPFA AT EJA AND VILLAMAYOR (ZARAGOZA) PILOTS; (DOWN) SOIL-CEMENT LAYER AT LA FONT DE LA FIGUERA (VALENCIA).

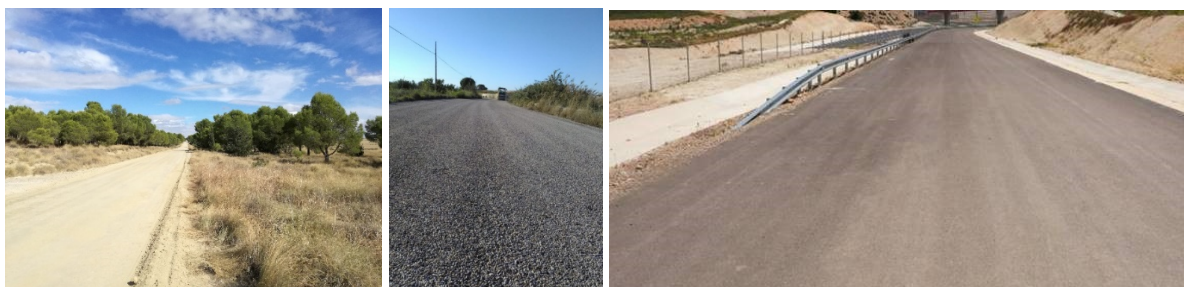


FIGURE 4 – APPLICATION. (LEFT) RURAL (UNPAVED), PERI URBAN (PAVED) AND HIGHWAY (RIGHT)

TABLE 1 PAPERCHAIN CIRCULAR CASE 2 ROADS BASED ON WPFA, MAIN ITEMS

<i>item</i>	<i>Description</i>
<b>PAPERCHAIN STAKEHOLDERS</b>	SAICA (WPFA producer), ACCIONA CONSTRUCCIÓN (Constructor); UPC and TECNALIA (Research partners)
<b>LOCATION</b>	Pilot 1 in Ejea de los Caballeros (Zaragoza, -SPAIN-). Stabilized soil type 2. Pilot 2 in Villamayor de Gállego (Zaragoza, -SPAIN-). Stabilized soil type 1. Pilot 3 in La Font de la Figuera (Valencia, -SPAIN-). Soil-cement layer.
<b>WASTE</b>	Waste Paper Fly Ash (WPFA)
<b>PRODUCT</b>	Alternative binder for replacement of cement or quicklime in soil stabilization works in road projects. Normal hardening hydraulic road binders (nHRB).
<b>APPLICATION</b>	Stabilized soil layers and soil-cements for different type of roads (rural, urban, Highway, paved and unpaved roads).

TABLE 2 CC2 HRB BINDERS BASED ON WPFA. KEY FACTORS AND LESSONS LEARNT

<i>Key Factor</i>	<i>Fact</i>	<i>Lessons learnt</i>
<b>Waste (WPFA)</b>	Waste Paper Fly ash (WPFA): classified as no-hazardous. Chlorides and Aluminium rich waste. Light weight material.	WPFA composition can be very variable depend on recycling plant technology. Chlorides and heavy metals must be specifically monitored to avoid uncorrect technical and environmental performance. Material low density can suppose an increased transportation costs.
<b>Regulatory framework</b>	UNE EN 13282-1:2013 Hydraulic road binders EU Standard permits to employ paper sludge ash (WPA).	Incompatibility or lack of specific regulation about the use of WPFAs in road construction for certain countries limits the application possibilities.

<b>Proceedings</b>	Some MS, such as Spanish regulatory framework does not recognize EN 13282. In addition, Binders obtained through mixing of their constituents on site are not covered by this European Standard	
	<p>WPFA production conditions in plant can be well controlled and be homogeneous to provide a regular quality WPFA. A more difficult condition suppose on-site WPFA-soil mixing.</p> <p>Actual mixing processes can be adapted to work with the WPFAs as binders in soil stabilization.</p>	<p>WPFA can replace cement satisfactorily, while environmental risks can be acceptable if correct proceedings are followed.</p> <p>“Bussiness as usual” processing of WPFAs as binders in hydraulic road binders can be achieved.</p> <p>Dust generation during the construction works must be minimized when on site mixing, to avoid any environmental problem.</p>
<b>Barriers</b>	<p>Lack of specific regulation on WPFAs use as binder.</p> <p>WPFA lower density.</p> <p>WPFA are produced in few plants across EU.</p>	<p>WPFA classification as “waste” generates distrust and prevent its valorization by the sector. Standard alternatives are still cheap.</p> <p>WPFA low density limits its marketable maximum radius due to higher transportation costs respect to other standard binders.</p>
	<p>WPFA based soil layers mechanical properties, workability, and even environmental performance achieve the required quality.</p>	<p>WPFA technical suitability in binder replacement for road construction.</p>
<b>LCA/CO2 footprint</b>	<p>All pilots have shown a good technical performance after 3 years and no environmental impacts have been identified, showing a similar trend in metal mobility to other conventional stabilisations.</p> <p>Quicklime or other standard binders have a greater carbon footprint.</p>	<p>WPFA has demonstrated its hability as hydraulic road binder, complying with all technical requirements stablished in the Spanish Road Regulations, equiparable to EU construction standards.</p> <p>Use of WPFA binders reduce the carbon footprint and increase circularity rate. Nevertheless, the CO<sub>2</sub> footprint derived from WPFA transportation must be well</p>

<p><b>Exploitation</b></p>	<p>Customers (Public and Authorities), demand guarantees about the WPFA quality, and more evidences about soil stabilization long-term performance (durability, mechanical strength, etc.). Demand of more evidences.</p> <p>Exploitation is highly limited to a closer maximum feasibility ratio than a standard binder due to its low density – increased transportation costs.</p> <p>No incentives for WPFA valorization in some MS.</p>	<p>analysed prior CEM is planned to avoid higher CO<sub>2</sub> footprint. A maximum transportation ratio, must be defined, depending on the available transportation type.</p> <p>Product certification according to EN 13282-2 is not possible in this case, so that, ACCIONA is applying for a Technical Conformity (TC). The process has already been launched with the Notified Body representatives (TECNALIA) Certification of the product quality is mandatory for its introduction in the market as construction material.</p>
<p><b>Replicability potential</b></p>	<p>High replication potencial through several WPFA producing plants across EU.</p>	<p>Limited its use to areas close to WPFA producers and considering a lower transportation ratios than standard fillers.</p> <p>Environmental perfromance: WPFA composition (chlorides, heavy metals) must be monitorized since they can be very variable among WPFA producers. The application scenario can be more or less environmenatlly sensible, then , the risk analysis must be specific to case.</p>