

A methodology to value reservoir sediment in fired-clay industry

HAURINE Frédéric^{1,2}

COJAN Isabelle², BRUNEAUX Marie-Anne¹

¹ CTMNC Centre Technique de Matériaux Naturels de Construction, Service Céramique,
17 rue Letellier 75015 PARIS - France - frederic.haurine@mines-paristech.fr

² MINES-ParisTech, PSL Research university, Centre de Géosciences,
35 rue St Honoré 77305 FONTAINEBLEAU Cedex - France

Preservation of natural resources becomes an important issue in the general frame of European environmental policies. Clay deposits in river, in particular associated with hydraulic structures (dams, harbors, locks,...), constitute potential alternatives to the quarrying of geologic formations. Through the example of the Durance watershed, we present a methodology to recover sediments considered as waste by industrial operators by enhancing their value in the fired-clay industry.

The Durance River and its tributaries are characterized by an important flux of suspended particulate matter (SPM). A large part of these SPM (more than 1Mt/year) is trapped in the 17 reservoirs of hydropower dams built along the Durance watershed. Compared with the annual consumption of raw material by the French fired clay industry (7Mt/year), this flux is quite significant.

To assess the potential of reservoir sediment, an industrial referential has been established from a set of 35 industrial samples. It is based on grain size distribution, mineralogical content (bulk rock and clay minerals) and geochemical compositions. All reservoir sediments are analyzed according to this protocol. For samples within the appropriate values, tests specific of the fired clay industry (firing, drying, resistance ...) are conducted. When necessary, mixture with sand, calcined clay, other sediment or fossil material are prepared to reach characteristics similar to that of the industrial referential.

In the upper course of Durance river (particularly in Serre Ponçon dam reservoir), SPM present high content in illite and chlorite and a coarse grain size distribution which are not favorable for direct use in the fired-clay industry. In the middle course, smectites and kaolinite content increases in the SPM associated to a larger CaCO₃ content. SPM from Verdon River (main tributary of Durance) present similar mineralogical content. This change in mineralogy is explained by the important contribution from sedimentary formations like the Jurassic marls. High CaCO₃ content can create some defaults during shaping or firing as observed in the Verdon samples (Castillon dam reservoir). Downstream of the Durance-Verdon confluence (Cadarache dam reservoir), CaCO₃ content and clay_mineral composition in SPM are close to expected values for use in the fired-clay industry, due to the mix of SPM from upper Durance and Verdon. All fired-clay laboratory tests could be performed on the Cadarache samples although the grain size distribution seems too fine for an industrial use. For better characteristics, mixtures were prepared by adding sand or calcined clay. Both the grain size distribution and geochemical composition were improved without significantly modifying their drying and firing properties. To value as much as possible reservoir sediments, other mixtures were successfully prepared, one with Cadarache and Serre Ponçon samples and another with a Cadarache sample and an industrial clay mixture.

These results on the Durance watershed reveals that substitution of clay from geologic formations by modern reservoir sediments is feasible and can represent a significant mass when compared to the French fired-clay industry consumption. It also reveals that mixtures between reservoir sediment or with waste from fired-clay industry, or industrial clay qualify some reservoir sediments that were not suitable based on their mineralogical compositions. This type of incorporation of “waste reservoir sediment” in the fired-clay industrial process will allow to reduce the consumption of non-renewable raw material and to extend the extraction duration of quarries.