Towards net-zero sediment management of inland waterways – comparing embedded and embodied carbon emissions for dredging and reuse scenarios

Richard Lord[1], Keith Torrance[1], Alasdair Hamilton[2], Paul Berry[2], Peter Birch[3].

[1]Civil & Environmental Engineering, University of Strathclyde, 75 Montrose Street, Glasgow, G1 1XJ, Scotland.

[2]Scottish Canals, Canal House, 1Applecross Street, Glasgow, G4 9SP, Scotland.

[2]Canals & Rivers Trust, National Waterways Museum, Ellesmere Port, Cheshire, CH65 4FW, England.

Phone: +44-(0)-7815-703567

E-mail: richard.lord@strath.ac.uk

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Introduction: Dredged sediments from inland waterways typically contain higher levels of organic matter than marine sediments (averaging 12 % solid organic matter in UK canals). Ongoing degradation releases CO_2 and the potentially more potent greenhouse gas CH_4 while the sediment is still *in situ*. After disturbance and dredging this may continue at differing rates with different proportions of methanogenesis and oxidation, depending on the type of dredging, disposal or reuse options chosen. As a consequence, attempts to manage and reduce the greenhouse gas emissions from dredging and sediment removal or relocation should consider the fate of this embedded carbon in the form of organic matter in addition to the embodied carbon resulting from operational activities and transport fuel use. The aim of this paper is to compare the embedded and embodied carbon for the annual canal dredging activity in England and Wales, together with scenarios for the likely effects of typical dredging and sediment reuse or disposal options.

Methods: The annual operational carbon emissions (embodied carbon) for the Canal & Rivers Trust provided by their national dredging team framework contract are compared with the estimated organic carbon content of the c 100,000 tonnes which are dredged annually (embedded carbon). Using the most common dredging and reuse scenarios, qualitative estimates of the relative emissions during and after dredging operations are suggested.

Results: Fuel use carbon emissions including diesel plant operation, plant mobilization, personnel travel and disposal haulage (for 55% of arisings) are estimated as 1340 tonnes CO_2 equivalent. Assuming 38% dry matter content, 12 % total organic matter on a dry basis and 58% carbon content of the organic matter, the 100,000 tonnes of wet sediment contain 2645 tonnes of organic carbon. If fully oxidized this would equate to 9706 tonnes of CO_2, so roughly 7 x the operational CO2 emissions, far greater than this if the long term storage conditions of the sediment promote methanogenesis. These calculations indicate the importance of considering the fate of embedded carbon within the dredged sediment if estimating the whole life emissions of a dredging project.

Discussion: Dredging options for UK canals include reallocation by ploughing, cutter suction and hydraulic transfer, or most commonly, pontoon-mounted excavation for barge transfer and road haulage. Arguably these represent successive increases in the expected operational emissions. Reallocation, dewatering and disposal result in similar or enhanced rates of emissions from oxidation of embedded carbon, with landfilling likely to enhance methanogenesis. However, nature-based solutions reusing sediment for soil creation and revegetation can be shown to lead to storage and future increases in soil carbon, so could be used to offset the operational emissions of dredging activity. In conclusion, using low carbon or renewable energy will not in itself achieve Net Zero dredging, so sediment managers must consider the fate of embedded carbon after dredging and reuse or disposal.

Fig. 1: Oxidation of organic matter at edges of sediment desiccation polygon, Kleiriperi, Delfzijl.