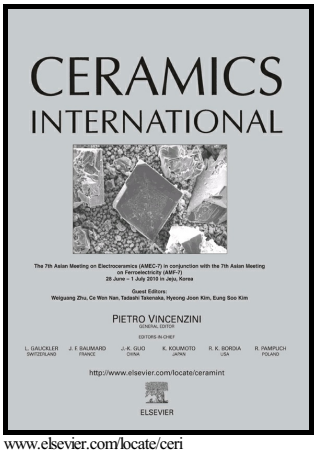

www.elsevier.com/locate/ceri

The importance of the amount/thickness of die wall lubricant for UO_2 pellets pressing

Ousseïni Marou Alzouma, Franck Marion, Anne-Charlotte Robisson

PII: S0272-8842(18)30801-0
DOI: https://doi.org/10.1016/j.ceramint.2018.03.224
Reference: CERI17861

To appear in: *Ceramics International*

Received date: 16 January 2018
Revised date: 25 March 2018
Accepted date: 25 March 2018

Cite this article as: Ousseïni Marou Alzouma, Franck Marion and Anne-Charlotte Robisson, The importance of the amount/thickness of die wall lubricant for UO_2 pellets pressing, *Ceramics International,* https://doi.org/10.1016/j.ceramint.2018.03.224

The importance of the amount/thickness of die wall lubricant for UO_2 pellets pressing

Ousseïni Marou Alzouma*, Franck Marion, Anne-Charlotte Robisson

CEA/DEN/DEC, Cadarache, 13108 Saint-Paul-Lez-Durance, France

*ousseini.maroualzouma@cea.fr
franck.marion@cea.fr
anne-charlotte.robisson@cea.fr

Abstract

External lubrication is often used to complete compaction process of powder materials. The main goal of this method is generally to reduce the amount of admixed internal lubricant (Zinc stearate powder) within the raw material. The application of external lubricants enhances the density uniformity and the mechanical strength of the resulting compacts. This study investigates the effects of the external lubricant amount for UO_2 powder compaction and the properties of the corresponding green pellets (corresponding to the compacts before sintering) without any admixed lubricant in the raw powder in order to evaluate the feasibility of this route in the case of nuclear powder. Results show that there is a quantity or number of layers from which the external lubricant applied on the die wall becomes detrimental to the friction index and the ejection force measured during the pressing cycle. The quality (surface defects, mechanical strength) of the green pellets can also be affected by the amount of lubricant. Thus the quantity and the thickness of the die wall lubricant must be optimized in order to assure an efficient mixed lubrication mode corresponding to the better lubrication mode in our study case.

Keywords: Lubrication, friction index, Ejection force, Pellets, Compaction, Nuclear fuel, Zinc stearate, Die wall, Uranium, Density, Powder, Tribology

1. Introduction

Die wall lubrication or external lubrication during compaction is widely used in several technological fields such as powder metallurgy [1, 2 ,3], pharmaceutics [4, 5, 6] ceramic powders [7, 8], coal logs [9] and also in nuclear fuel [10, 11] in order to reduce friction phenomena at the interface between the compacted powder and the die wall.
Recently, C. Machio et al. [1] demonstrated that dry compaction of TiH_2 powder, without lubricant on die wall, causes the welding of TiH_2 particles onto die wall and the rupture of the pellets during ejection while, when external lubricant is applied, green pellets (compacts before sintering) strength and densities are enhanced according to the lubricity of the lubricant and the ejection force is reduced. The same advantages are observed also in coal log compaction [9] and for pharmaceutics [5, 6]. Furthermore, contrary to internal lubrication, die wall lubrication avoids unwanted internal density distribution and allows low and stable friction coefficient as observed in ceramics compaction with zinc stearate [7]. Also, it has been demonstrated that die wall lubrication reduces a need of admixed lubricant in the powder to compact [2, 3] when both lubrication routes are combined.
However, there is no data available concerning the tribological consequences of the amount or thickness of the coating deposited on the die wall on the properties of the metallic or ceramic compacts which ensued from the pressing experiences without any presence of internal lubricant.
This work investigates the influence of the number of lubricant layers deposited on the die wall for UO_2 pressing. Data recorded during pressing and ejection steps and characteristics of the UO_2 green compacts are discussed according to the amount of lubricant applied on the die wall.

2. Experimental details

2.1. Raw material

A batch of dry processed UO_2 powder elaborated by ANF Lingen is used to carry out the experiences. It contains around 8.5% of U_3O_8 additives. The powder depicted in Fig. 1 presents a large particle size distribution (from 0.5 µm to 150 µm) and the diameter of the maximum UO_2 particles is 150 µm with a global over-stoechiometric amount in oxygen such that x = 0.13 in UO_{2+x}. The initial particle size distribution of UO_2 powder is made by Laser Diffraction with Beckman Coulter LS13320 device and shown in Fig. 2.