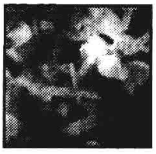
Environmental Issues and Waste Management Technologies in the Ceramic and Nuclear Industries VI

Edited by
Dane R. Spearing
Gary L. Smith
Robert L. Putnam

Ceramic Transactions
Volume 119



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Proceedings of the Waste Management Science and Technology in the Ceramic and Nuclear Industries and Science and Technology in Addressing Environmental Issues in the Ceramic Industry Symposia at the 102nd Annual Meeting held April 29–May 3, 2000, in St. Louis, Missouri.

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Cover photo: "Transmission electron micrograph of zirconia/alumina based waste form displaying magnetoplumbite platelets and equiaxed grains of zirconia and other phases," is courtesy of E.R. Maddrell and M.L. Carter, and appears as figure 2 in their paper "Titanate Ceramics for the Immobilisation of High Level Waste from Advanced Purex Reprocessing Technology," which begins on page 175.

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Preface

Crystalline and glassy ceramics continue to play an increasingly important role in environmental issues and waste management. As an example, the United States Department of Energy recently decided that crystalline ceramics would be the matrix of choice for the disposition of surplus weapons-grade plutonium and clean actinide metals. This record of decision by the DOE precipitated a great deal of discussion within the Nuclear and Environmental Technology Division at the 102nd Annual Meeting of The American Ceramic Society in St. Louis, Missouri, and resulted in two new sessions: "The Role of Spinel in Nuclear Waste Ceramics," and "Thermodynamics and Characteristics of Titanium-Bearing Nuclear Waste Forms."

This volume is the proceedings from the Waste Management Science and Technology in the Ceramic and Nuclear Industries and the Science and Technology in Addressing Environmental Issues in the Ceramic Industry symposia and represents the eighth in the series of The American Ceramic Society's Ceramic Transactions volumes on the subjects of waste management and environmental issues. Previous proceedings on nuclear waste management include Advances in Ceramics volumes 8 and 20, and Ceramic Transactions volumes 9, 23, 39, 45, 61, 72, 87, 93, and 107.

First and foremost, the editors would like to thank the authors and reviewers, without whom such a high-quality proceedings volume would not be possible. We also would like to acknowledge the session chairs, Vijay Jain and Jasper Kwong, for their contribution in keeping the presentations running smoothly. In addition, we would like to thank James Bennett, who helped pull together the environmental issues session on recycling of ceramic byproducts at the last moment. Lastly, the editors would like to thank the book publishing team at The American Ceramic Society: Mary Cassells, Sarah Godby, and Jennifer Brewer. Their contributions were instrumental in the publication of this volume.

Dane R. Spearing

Gary L. Smith

Robert L. Putnam

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Vitrification and Process Technologies

The Role of Spinel in Nuclear Waste Ceramics

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POWER FOR PEACE, PROSPERITY, AND THE ENVIRONMENT

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ABSTRACT

The remarkable prosperity and standard of living enjoyed in the United States is in large part linked to our use of energy. While high-energy use brings many benefits, it also causes environmental degradation. In the last decade, the potentially devastating effects of degradation of greenhouse gases have received worldwide attention. The tradeoff between sustaining a healthy environment and sustaining a healthy economy is a major challenge of the 21st century. In this paper, we explore some of the issues and focus particularly on the option of enhancing nuclear energy as a way to help sustain economic prosperity while decreasing pollution of the atmosphere.

INTRODUCTION

As the United States, and to some extent the rest of the world enjoy record prosperity, we are struggling with how to protect the environment. This balance of power for prosperity and the environmental impact is one that relies on technology as well as policy to address. To the first approximation, the use of power or energy equals prosperity. The U.S. leads by a large margin in the use of energy per capita (Figure 1). While we are large users of energy, we are fairly efficient users as shown by energy intensity per GDP (Figure 2). As a major energy user, the U.S. contributes significantly to the greenhouse gas production in the world.

* Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under Contract DE-AC04-94AL85000.

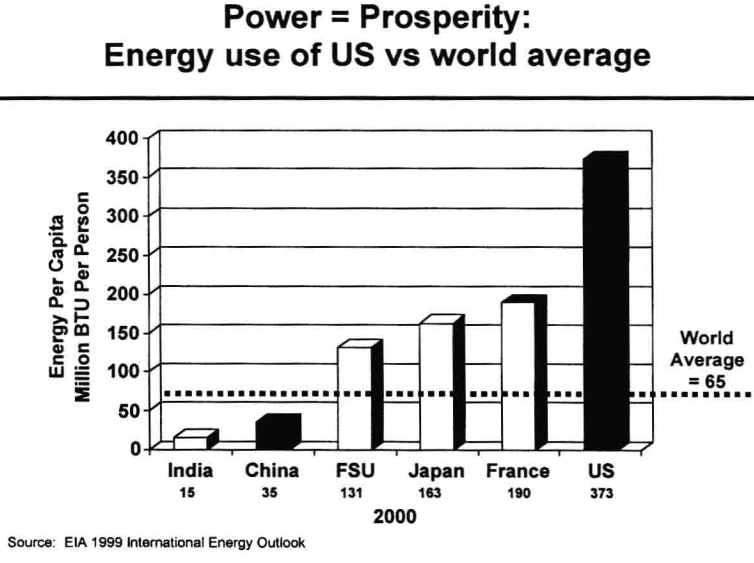

Figure 1. The U.S. leads the world in energy use perception.

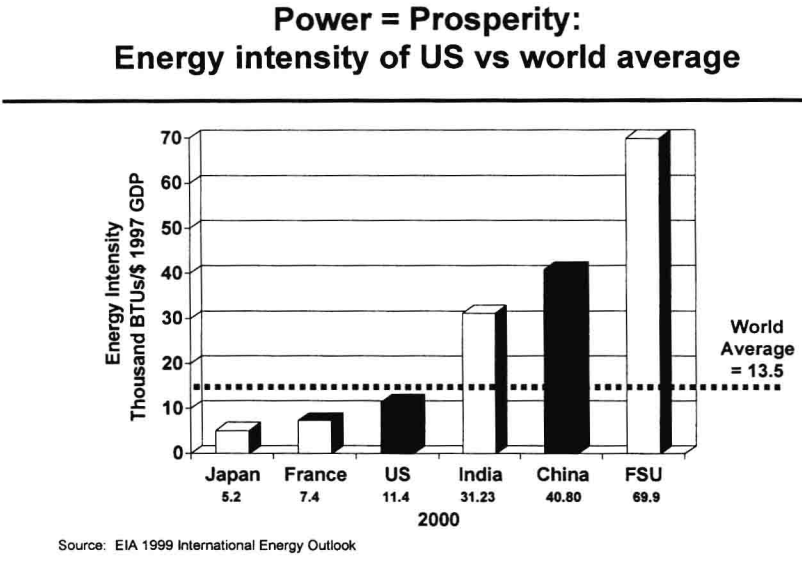

Figure 2. The U.S. uses energy with somewhat less efficiency than other developed countries.

Worldwide global greenhouse gas emissions measured by tons of carbon, could more than triple by 2050 if current use patterns continue (Figure 3). Most of this growth occurs in developing nations and is linked to extensive coal use as a source for generating electrical power.