

**Stavros Moschidis**

Current US legislation on the  
environmental, health and safety impact of  
nanomaterials in coating products

**Master's Thesis**

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HERIOT-WATT UNIVERSITY

***THE ADEQUACY OF THE CURRENT UNITED STATES LEGISLATION TO MANAGE  
THE ENVIRONMENTAL, HEALTH & SAFETY OF NANOMATERIALS IN COATING  
PRODUCTS***

*by*

***Stavros Moschidis***

*Dissertation*

**Erasmus Mundus Master in Chemical Innovation and Regulation**

July 2015

## Declaration of Authorship

I declare that I am the author of this work, which is original. The work cites other authors and works, which are adequately referred in the text and are listed in the bibliography.

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Stavros Moschidis

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## Abstract

This study represents an analysis of the ability of current US environmental, health and safety regulations at a federal level to manage the risk posed by nanomaterials in coating products. Alongside the functional benefits from the use of nanomaterials in coating applications (e.g. antimicrobial, UV protection, anticorrosive, anti-scratch properties, etc.), there are concerns regarding the exposure of humans and the environment during the manufacture, processing, development, use and end of life stage of these materials. A life cycle paradigm is used, examining all regulations relevant to coating applications, identifying the issues in each regulatory framework but also, horizontal issues that govern all of them. This thesis makes an important contribution to the identification of which regulatory frameworks are the least effective and whether any changes are required.

Chapter 2 presents a list of nanomaterials which are used in coatings and the functional benefits that derive from their use. In Chapter 3, nanomaterial release from coating applications during the whole lifecycle are analyzed to evaluate potential exposure scenarios. This analysis aims to reveal the mechanisms of release and the possible exposure routes in each lifecycle stage. The released nanomaterials are likely to behave differently compared to the pristine (as produced) nanomaterials and more studies should investigate in more detail the potential hazards of nanomaterials at different stages of their lifecycle.

In Chapter 4, the US regulatory map relevant to coating applications is presented, and the specific issues in each statute discussed but also, cross-cutting issues across all lifecycle stages. The regulatory review draws out a number of issues regarding nanomaterials that need to be addressed towards a comprehensive regulatory scheme. Moreover, issues have been detected in the new proposed rule under Toxic Substances Control Act, the most relevant regulation to supervise coating products, which need to be addressed before the final promulgation.

Finally, in Chapter 5, the effectiveness of each regulatory framework based on simplistic method is assessed, by applying specific criteria appropriate to nanomaterials such as if nanomaterials are covered, if risk review is triggered, the availability and sufficiency of toxicological and exposure data, and risk communication effectiveness. According to these criteria, the preliminary regulatory screening show RCRA and CPSA are the most problematic regulations, followed by



the CAA, CWA and CERCLA, the TSCA and at the end OSHAct. FIFRA has been found the most adequate regulatory framework. This analysis concludes that the capacity of the existing US regulatory system to address potential nanomaterial risk in coating applications is poorly able to do so. It also prioritizes the different statutes that need to be amended first, in the case of an incremental regulatory approach to ensure a better oversight. Prior to any regulatory change, regulators should focus to resolve the horizontal problems. But adequate regulatory authority is not the only requirement for a successful regulatory program. Sufficient resources of personnel and money and the will to use the resources and authority also are necessary.

## Table of Contents

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Abstract .....	iii
List of Tables.....	vii
List of Figures.....	viii
List of Abbreviations.....	ix
Acknowledgements.....	x
Dedications.....	xi
1. Introduction.....	1
1.1    Background of the study .....	1
1.1.1    Nanotechnology .....	1
1.1.2    Coatings .....	2
1.1.3    Risk Regulations & Nanotechnology.....	4
1.2    Aim & Objectives of the Study .....	6
1.3    Boundaries of the study.....	7
2. Nanomaterials in Coatings in the USA Market .....	9
2.1    Nanomaterial Types Used in Coatings.....	10
2.2    Functional Benefits of Nanotechnology-based Coatings .....	11
3. Risks Posed by Coatings containing Nanomaterials.....	14
3.1    Hazards of Nanomaterials used in Coatings .....	14
3.2    Potential Releases.....	18
3.2.1    Potential Releases from the Nanomaterial Manufacturing Stage .....	18
3.2.2    Potential releases during the Material Processing Stage & NM-Coating Manufacturing.....	19
3.2.3    Potential Release of NMs from Coating Applications during Use Stage .....	21
3.2.4    Potential Release during the Incineration, Land-filling & Waste Water Treatment Stage.....	23
4. Life Cycle Regulations of Nanocoatings .....	25
4.1    Horizontal Issues across all Regulations.....	28
4.1.1    Absence of Nano-Definition .....	28
4.1.2    Failure of Reporting of Nanomaterials in Commercial Use and Fuzzy Commercialization Paths .....	30

4.1.3	No Standardized Methods.....	31
4.1.4	Poor Risk Communication.....	32
4.2	Pre-market Stage Regulations.....	33
4.2.1	TSCA Regulatory Issues.....	33
4.2.2	Ineffective Characterization at Different Life Cycle Stages.....	42
4.2.3	Federal Insecticide, Fungicide, and Rodenticide Regulatory Issues.....	44
4.3	Use Stage Regulations.....	45
4.3.1	Consumer Product Safety Act Issues.....	45
4.4	End of Life Regulations .....	47
4.4.1	Resource Conservation and Recovery Act Issues.....	47
4.4.2	The Comprehensive Environmental Response, Compensation, and Liability Act Regulatory Issues .....	50
4.5	Regulations along Lifecycle.....	51
4.5.1	OSHAct Issues.....	51
4.5.2	Clean Air Act & Clean Water Act Issues .....	53
5.	Analysis & Discussion.....	56
5.1	Analysis.....	56
5.2	Discussion .....	63
6.	Conclusions.....	69
7.	References.....	71