



Innovative strategies, methods and tools for occupational risks management  
of manufactured nanomaterials (MNMs) in the construction industry

## SELECTION OF REPRESENTATIVE PPEs USED IN THE CONSTRUCTION SECTOR FOR EFFICIENCY TESTS

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## **1. EXECUTIVE SUMMARY**

This report concerns the selection of personal dermal protection equipments (PPEs) whose efficiency concerning the nano exposition via aerosols will be tested. The tests of efficiency when the exposition is via powder or via colloidal solutions will be done by the partner TECNALIA. The tests of efficiency concerning respiratory protection will be done by the partner (CIOP).

## **2. OBJECTIVE AND SCOPE**

This report concerns the selection of personal dermal protection equipments (PPEs) whose efficiency concerning the nano exposition via aerosols will be tested. The tests of efficiency when the exposition is via powder or via colloidal solutions will be done by the partner TECNALIA. The tests of efficiency concerning respiratory protection will be done by the partner (CIOP).

We have done a research of dermal personal protection equipment (PPEs) in different catalogues of materials of security.<sup>1</sup> Among all the PPEs and taking into account the exposure to the nanorisks, we have excluded the helmets and the boots because they are in general made of rigid and very thick materials, therefore we expect that they are less permeable to nanomaterials when compared with the protective clothing.

We have chosen protective clothing and gloves that could be interesting for the persons working on building construction and public works.

Therefore we eliminated the products that are very sophisticated and we retained the PPES that are comfortable to the cold and to the heat and also the PPES that are dedicated to strong efforts and evacuate the transpiration. The selected PPES are presented in table 1.

Type of materials	Chemical Nature	Weight /m <sup>2</sup>	Type of PPE
Woven materials	Cotton 100%	180 - 250 g/m <sup>2</sup>	T-shirt ; jacket ; gloves
		260 -330 g/m <sup>2</sup>	Coverall ; jacket
	Polyester 65% / cotton 35%	245 - 350 g/m <sup>2</sup>	T-shirt ; jacket
		245 - 350 g/m <sup>2</sup>	Coverall; Jacket
Non-woven materials	Polyester 100%	300 - 340 g/m <sup>2</sup>	Jacket ; polar ; gloves
	Polyethylene	41 - g/m <sup>2</sup>	Coverall "Tyvek"
	Polypropylene	45 – 280 g/m <sup>2</sup>	Coverall "Tychem"
	Leather		Gloves
Coated materials	Polyester 94% Spandex 6%	310 g/m <sup>2</sup>	Rain jacket
	PVC coated polyester		Rain jacket
	PU coated polyamide		Rain jacket
	Coated cotton		Gloves

Table 1: Dermal personal protection equipments (PPEs). PVC stands for polyvinyl chloride, PU stands for polyurethane. Nylon is made of repeating units linked by amide bonds and is frequently referred to as polyamide (PA).

### 3. METHODOLOGY TO TEST PERSONAL DERMAL PROTECTION EQUIPMENTS (PPEs)

The methodology (experimental set-up) proposed by the CEA to test the efficiency of PPEs typically used construction workers exposed to nanoaerosols was applied in the past to other type of PPEs typically used by laboratory workers.<sup>2</sup>

Previously different commercial conventional individual protection devices were tested for different types of polydispersed nanoaerosols of TiO<sub>2</sub>, Pt, and graphite at CEA-LCSN facilities.<sup>2</sup>The electrical mobility diameters of the generated particles were between 9 to 19 nm for Pt, 9 to 90 nm for TiO<sub>2</sub>, and 15 to 90 nm for graphite.

The following conventional individual protection devices were tested:

- Respiratory protection: HEPA filter (glass, H11 according, EN 1822) and electrostatic filter (polypropylene, FFP3 according, EN 149);
- Dermal protection: Woven protective clothing (cotton and polyester), Non-woven protective clothing (High-density polyethylene textile Tyvek); gloves (Nitrile, Latex, Neoprene).

The main conclusions were the following:

- Respiratory protection: The HEPA filters show a higher efficiency for graphite nanoaerosols than for TiO<sub>2</sub> and Pt nanoaerosols. The HEPA filter efficiency for TiO<sub>2</sub> and Pt nanoparticles is in the same order of magnitude. At the most penetrating particle size, approximately 35 nm, the electrostatic FFP3 filter is more efficient for graphite than for TiO<sub>2</sub> nanoparticles
- Dermal protection: Cotton and polyester clothing showed nearly same efficiencies as the one achieved when tested with TiO<sub>2</sub> and Pt nanoparticles with mean geometric diameter around 10 nm. Air-tight fabrics made of non-woven textile seem to be much more efficient in protecting workers against Pt, and TiO<sub>2</sub> nanoparticles, than cotton and polypropylene. The former protective clothing showed nearly the same efficiency as that for TiO<sub>2</sub> and Pt nanoaerosols if exposed to the same concentration. Gloves are found to be very efficient for TiO<sub>2</sub> and Pt nanoaerosols with particle size of mean geometric diameter around 10 nm. No nanoaerosol penetration through the gloves was observed.

## 4. REFERENCES

Haleco "l'expert environnement et sécurité" 2008; Fisher Scientific "sécurité" 2012; Descours-Cabaud online-catalogue.

L. Golanski, A. Guiot, F. Tardif "Experimental evaluation of individual protection devices against different types of nanoaerosols: graphite, TiO<sub>2</sub>, and Pt" (2010) *J Nanopart Res* (2010) 12:83–89

## 5. LIST OF FIGURES AND TABLES

Table 1: Dermal personal protection equipments (PPEs). PVC stands for polyvinyl chloride, PU stands for polyurethane. Nylon is made of repeating units linked by amide bonds and is frequently referred to as polyamide (PA).