FN NANO® METRO TUNNEL PROJECT

For *SAFE* air in underground transport

This is a request for collaboration from Advanced Materials-JTJ Ltd in Prague, Czech Republic to collaborate on an environmental remediation pilot-project in your home country.

Project Proposal Title:

METRO AIR POLLUTION REDUCTION PROJECT

Pilot Project to Examine Economical Air Purification in **Underground Transport** Systems in the EU, with the use of ***PHOTOCATALYTIC PAINT*** from the Czech Republic

In association with the Academy of Sciences of the Czech Republic, J. Heyrovsky Institute of Physical Chemistry and Advanced Materials-JTJ Limited, Prague.

INVITATION TO COLLABORATE

Basic tenets to this proposal

- The concept is to run a pilot project in a metro (subway, underground) in a city in the EU where pollution of many types exists, with the goal of reducing these pollutants.
- The project is to paint the ceiling of a metro tunnel between two stations, with our photo-catalytic coating, and install UV lighting that will activate the coating surface.
- The **FN NANO®** Multi-functional Coating developed at the Academy of Sciences Institute of Physical Chemistry is the most advanced coating yet developed and proven by many tests using ISO and other standards. The result of the coating's activity is to destroy pollutants by breaking apart the compounds at the molecular level, by pulling away electrons. The inert Titanium Dioxide used in the coating and the solution are not harmful, and there is no exceptional hazard associated with the coating.
- The pollutants that can be degraded, dissolved and decreased include: NOx, VOCs, Formaldehyde, Acetaldehyde, and Particle Matter (PM10, PM2.5).

- Measurement devices will be installed at the entrance (where the air flow will start) and at the exit (the location to where the air is propelled).
- The project is meant to be as unobtrusive as possible and be ideally executed on a tunnel ALREADY undergoing repair and/or renovation to lessen the burden of interrupted services to the users.

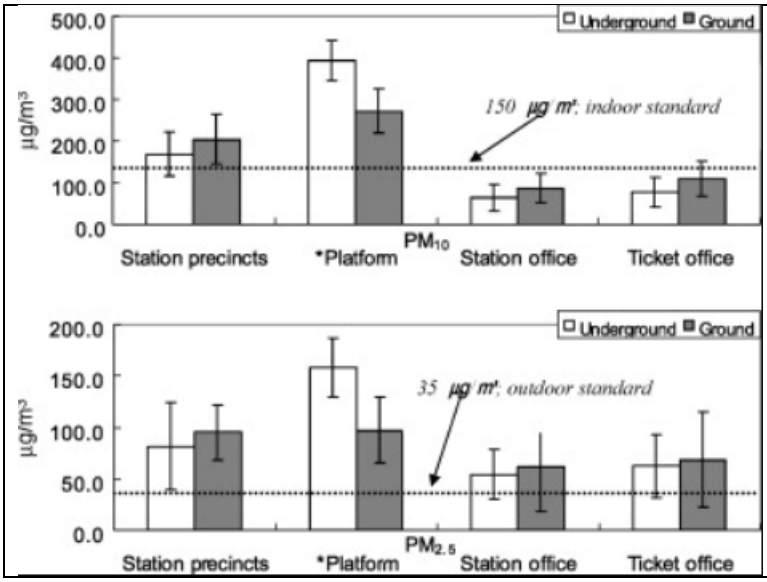
SUPPORT/FUNDING/SCIENTIFIC-COLLABORATION

The project organizer seeks funding for the project through any and all aid agencies, research organizations, and national governments. This letter requesting collaboration is for that purpose.

- The organizer seeks to utilize educational institutions if they see value in supporting with researchers and/or students.
- The organizer will ask government agencies to support this idea because it is economical and not dangerous, and it can show they are interested in seeking innovative mechanisms to address the problem.

MORE DETAIL ON PROJECT EXECUTION

Underground metro platforms tend to be unintentional collection points for many pollutants, primarily because they are below ground and are funneled into these subterranean areas. In these locations there is little ability for natural degradation and dispersion that is found above ground, and even with mechanical ventilation, these can accumulate to hazardous levels. See results of study done in Seoul, South Korea below. Platform areas where passengers board trains are the most hazardous.



* https://www.sciencedirect.com/science/article/pii/S0304389407014896

Photocatalysis has been proven to be useful in the reduction of many pollutants and Titanium dioxide is considered to be the most useful compound from economical point of view as well as in efficiency considerations.

And while the use of this type of coating has been studied quite actively over the last 30 years, none have achieved the strength of **FN NANO®** which cold be considered the 'second generation' of photocatalytic coatings due to the process of combining the TiO2 with the binder, allowing for a significantly large increase in surface area of the catalyst with the binder material, rather than suffering from light being blocked due to the medium of application such as resin, glues or cement.

FN NANO® properties have been tested since inception some ten years earlier, and have not been bested in all ISO standard tests by any other known product, and as a result has been patented globally.

Because of this efficiency and ease of use, similar to applying a thin and sprayable paint, it holds promising potential for the situation of pollution in underground transport. This project intends to

TUNNEL PARAMETERS

Assumptions

> The following will describe an underground metro tunnel that is undergoing a renovation or repair project, with assumptions of how the pilot project will be added, in terms of detail of size, length, area of surface, man-hours, cost of coating, ancillary costs, with room for diversion from the plan, as well as optional components or variations in the application theme. First, an "Ideal" project situation. Ideal Tunnel = (IT) Not Ideal Tunnel = (NT):

***Ideal project* situation for application of FN NANO®:**

(IT)1 The sample tunnel (ST) is 200 meters in length;

(IT)2 ST has tracks for the train cars, and electricity running through to power the train cars (below, "third rail") as well as cables along the walls to power the indicator lights for drivers.

(IT)3 ST has undergone renovation or repair,

(IT)4 The repairs required the removal and extensive cleaning of the area prior to the new application of surface material (tiles, mortar or other solid materials on the walls and ceiling) and the coating of **FN NANO®** can be applied over three days, in three thin layers of 5 microns each (potentially an additional day for a primer coating depending on the surface material).

(IT)5 The additional UV lighting structure can be constructed with stable aluminum frames, at gaps of approximately 10 meters, and powered through existing

supply cables (but installed even earlier than the spray application of the coating).

(IT)6 The tunnel closure time was estimated to last 3 weeks but will require an additional 3 days for a) installation of the UV lighting system, and b) 3 days for the application of the coating. (Total estimated *additional* days = 6).

***NOT-ideal variations* to the above that are still suitable for this project:**

(NT)1 The sample tunnel (ST) is 200 meters in length;

(NT)2 ST has tracks for the train cars, and electricity running through to power the train cars (below, "third rail") as well as cables along the walls to power the indicator lights for drivers.

(NT)3 ST has undergone renovation or repair, BUT has not undergone extensive cleaning and heavy soot, dust and other debris remains.

(NT)4 It is necessary to clean all debris and spray clean the surface to be coated with **FN NANO®**, possibly with a biocide to kill microorganisms. Removal of all loose material is necessary as to not interfere with measurements later (dust could rise and be counted as PM10).

(NT)5 the coating of **FN NANO®** can be applied over three days, in three thin layers of 5 microns each (potentially an additional day for a primer coating depending on the surface material).

(NT)6 The additional UV lighting structure can be constructed with stable aluminum frames, at gaps of approximately 10 meters, and powered through existing supply cables (but installed even earlier than the spray application of the coating).

(NT)7 The tunnel closure time was estimated to last 3 weeks, but will require an additional 3 days for a) installation of the UV lighting system, b) 3 days for the application of the coating and, c) more importantly, potentially 7 days for extensive cleaning prior to application of the coating. (Total estimated *additional* days = 13).

VARIABLES AND ESTIMATIONS

Estimations

Size of tunnel, surface space, lighting requirement, time to apply, preparation of surface, man-hours, cost of coating, delay of tunnel re-opening

In the attached table are variables for the metro tunnel project, taking into consideration items such as length, width of ceiling, manhours necessary, cost of FN NANO® coating, and many miscellaneous items (though it should be assumed more will arise). The ideal tunnel situation (IT) and the Not-ideal tunnel situation (NT) indicate that cleaning the surface area to a suitable application level for accurate testing could indeed add much time to the project.

It is therefore important that newly renovated tunnels or those with largely cleaned spaces, will be chosen over tunnels that have not been well cleaned.

The table and estimates assume a 200-meter tunnel, with a 15 meter wide ceiling area for 3000 meters of application, which will take a minimum of 3 days to cover (assuming the full area can be done in one day but also because 24 hours is necessary for complete drying).

The costs include the cost of the coating at near production cost levels, the manhours with estimated rates for workers of different experience or professional expertise, the cost of FN NANO® experts (2), and many other extra costs such as allowance for setting up, cleaning up, before and after a day's application; also included are the costs to install a frame for lights and the amount of lights necessary to illuminate with 365 nm UVA lighting at intervals of 10 meters, along the 200 meters.

Useful Video

The video on this website is useful as it runs continuously, and the view can appreciate the space to be coated (although it seems to be only 30 meters long). Short link http://bit.ly/FNTunnel1 (https://videohive.net/item/underground-tunnel/6525777)

VISUALIZING TUNNEL WORK

Tunnel Surface Variations

In London, the ceiling surfaces of the London Underground tunnels are usually not smooth because of the cladding type reinforcement. This type of situation poses problems because of the many surfaces and edges that need cleaning. On the other hand, it may prove advantageous because it may be more efficient to attach pre=coated panels to the surfaces. Perhaps three to 5 sections at a time. (It might even reduce air friction for the trains). See image just below.

Tunnels with smooth surfaces would be easier for the fn coating application.

(Smooth panels after TBM method)

More recently constructed tunnels with modern Tunnel Boring Method (TBM) will be useful in that the system applies panels to the walls that can be coated.

Tunnel Size

Enough space above (or on the side walls) must be available to install the framework for the lighting. Many London Underground tunnels are too small.

UV Lighting up and sideways

The photo here is of a car tunnel but the concept is the same.

The lighting needs to be attached to the ceiling and walls in a way that allows the light to shine up and sideways to the surface where the fn is applied.

UV lighting, in particular UVA with a narrow range of 365 nanometers, is the ideal wavelength necessary to activate the TiO2 in fn. The type of light that is able to cast lighting in enough intensity is important. More lighting is better than too little.