New Surface Coatings for the Prevention of Dust Accumulation, Pest Growth and Moisture Damage on Interior Food Production and Processing Factory Surfaces

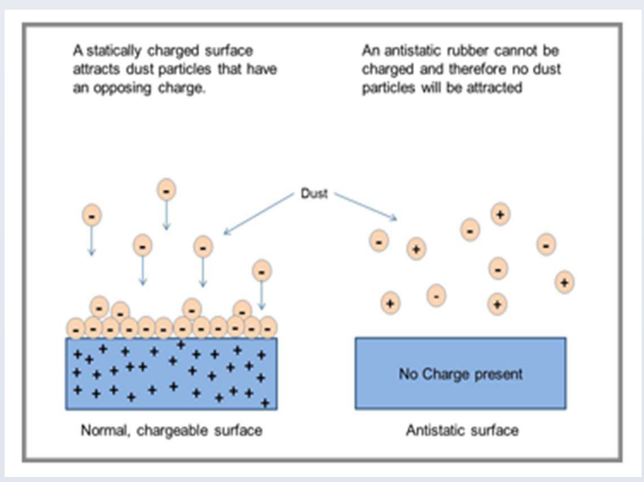
Sabancı Üniversitesi FACULTY OF ENGINEERING AND NATURAL SCIENCES

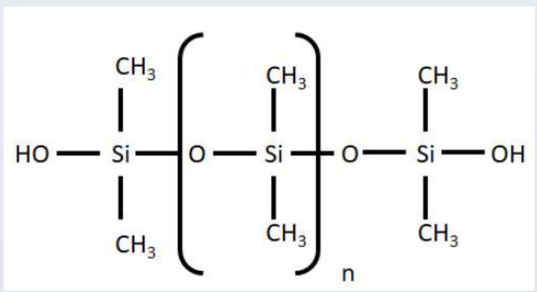
Unilever

Student(s)	Faculty Member(s)	Company Advisor(s)
Necdet Özçelik	Serkan Ünal Yusuf Z. Menceloğlu	Semih Apaydın

Abstract

Current coating materials for interior building surfaces in powder food processing and production factories do not offer solutions to prevent dust accumulation, pest growth or moisture damage. The project focuses on the investigation and development of novel surface coating solutions for such factories in collaboration with Unilever. Since there is remarkable dust accumulation on the vertical wall surfaces inside the building, which are difficult to clean frequently, the project comprises a hydrophobic and anti-static coating to prevent electrostatic attraction between the wall surface and dust particles in the air. The project also focuses on the design of a specific test in the laboratory environment to quantitatively investigate the accumulation of particular factory dusts on coated surfaces. The elimination of the food dust accumulation and moisture sensitivity of such surfaces is presumed to contribute to the prevention of pest growth in these areas. Several antistatic and hydrophobic coatings were synthesized and tested during the project. The coating is a polydimethylsiloxane (PDMS) containing waterborne two component anti-static polyurethane. PDMS improves the hydrophobicity, anti-static agent improves the dust prevention in this coating.





PDMS

Objectives

- Prevent dust accumulation
- Eliminate the effect of water and moisture
- Good mechanical property and chemical resistance for durability
- Easy application and potlife
- Safe for human health

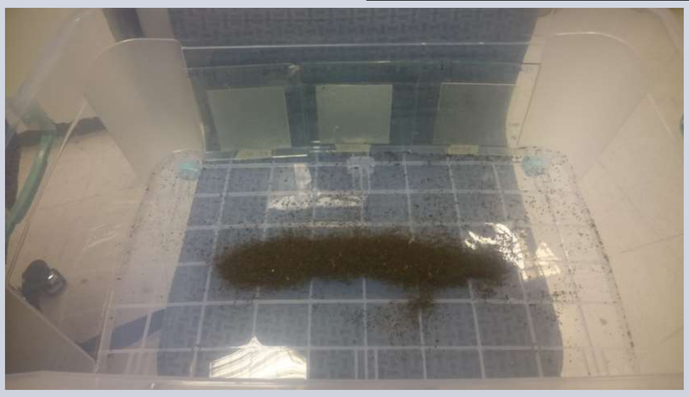
Synthesis

There were 3 waterborne two component polyurethanes synthesized by condensation polymerization.

1. PU with no PDMS
2. PU with %3 PDMS
3. PU with %6 PDMS

Different anti-static types and ratios were mixed to each polyurethane to find the most effective one.

Dust Accumulation Test



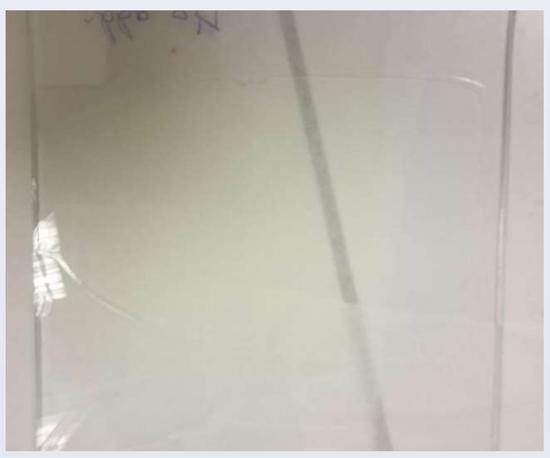
- This environment was prepared to dust accumulation test.
- Coatings were sticked to the walls then, dust particles were circulated into the box with a fan.

Results

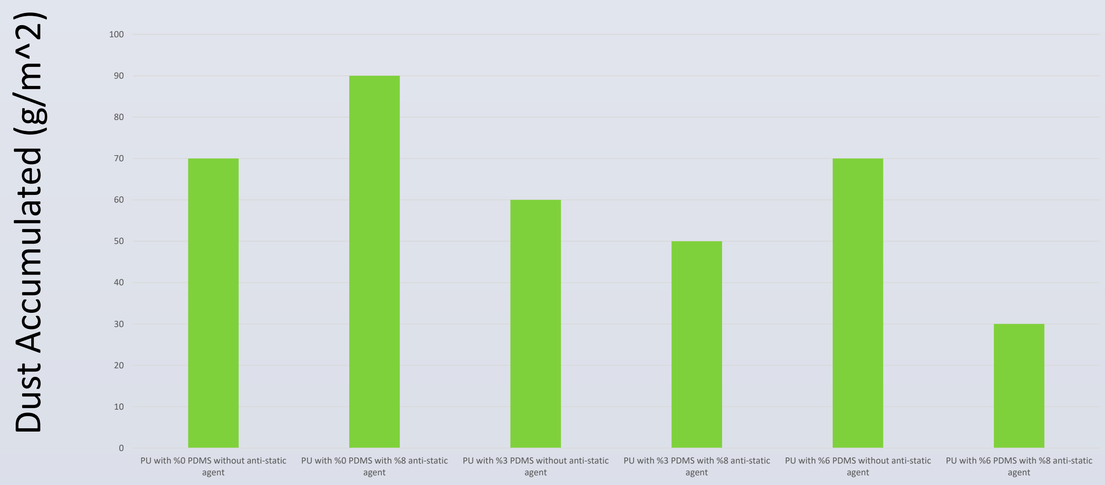
- Polyurethanes were succesfully synthesized
- The best anti-static agent was determined
- Adhesion to the surface was very good
- Solids content measurement, contact angle measurement, surface resistivity test, dust accumulation tests were completed
- Coatings are almost transparent, color becomes hazy with increased PDMS ratio

Coating	Contact angle	Resistivity without anti-static agent	Resistivity with agent
PU with %0 PDMS	78,5	1,00E+10	1,00E+08
PU with %3 PDMS	100,6	1,00E+10	1,00E+08
PU with %6 PDMS	98,5	1,00E+10	1,00E+08

Contact angle and resistivity measurements of polyurethanes
(Values are the average results of several measurements)



Dust Accumulation Test



Conclusion

- Hydrophobic and antistatic waterborne coatings were developed.
- The contact angle of coatings was 100°. Surface resistivity of the coating was improved to 10^8 ohms/square from 10^10.
- Dust accumulation tests indicated slightly improved dust resistance in hydrophobic, anti-static coatings.
- Dust accumulation tests will need further tests under different conditions to determine the optimum composition.

References

1 - Anti soiling coating composition and process for use thereof , Anthony Eoga, 4.07.2002

2- Super hydrophobic and antistatic composition, J. Mohan Sunder, Sameer Arvind Kapole, Subodh Deshpande, 07.08.2014

3- Silicone-containing polymer matrices as protective coatings: Properties and applications, MariaZielecka, ElżbietaBujnowska, 01.02.2006

4- Dust prevention compositions, coatings and processes of making, Samuel V. Costello, Brendan Byrne, 17.01.2017

5- Waterborne acrylic–polyaniline nanocomposite as antistatic coating: preparation and characterization, Abdolreza Mirmohseni, Ali Gharieh, Manouchehr Khorasani,26.10.2016

6- A facile approach to fabricate waterborne, nanosized polyaniline-*graft*-(sulfonated polyurethane) as environmental antistatic coating, Haihua Wang, Liyu Sun, Guiqiang Fei, Jie Fan, Xinyuan Shi, 22.06.2017

7- https://www.cht.com/cht/web.nsf/id/pa_antistatic-silicones-en.html