



Surface treatment for durable banknote paper

Chemical structure – performance correlation

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Summary

- Target description
- Samples selection
- Samples preparation
- Testing procedure
- Results
- Conclusions



Target description

- Banknotes are withdrawn from market mainly for soiling and «wear & tear» failures
- Extending banknote paper durability is crucial for reducing cost and enhancing sustainability
- Waterborne anionic polyurethanes are commonly used by banknote papermakers for manufacturing «durable» paper
- This work aim to identify a correlation between polyurethanes composition and performance that influence durability

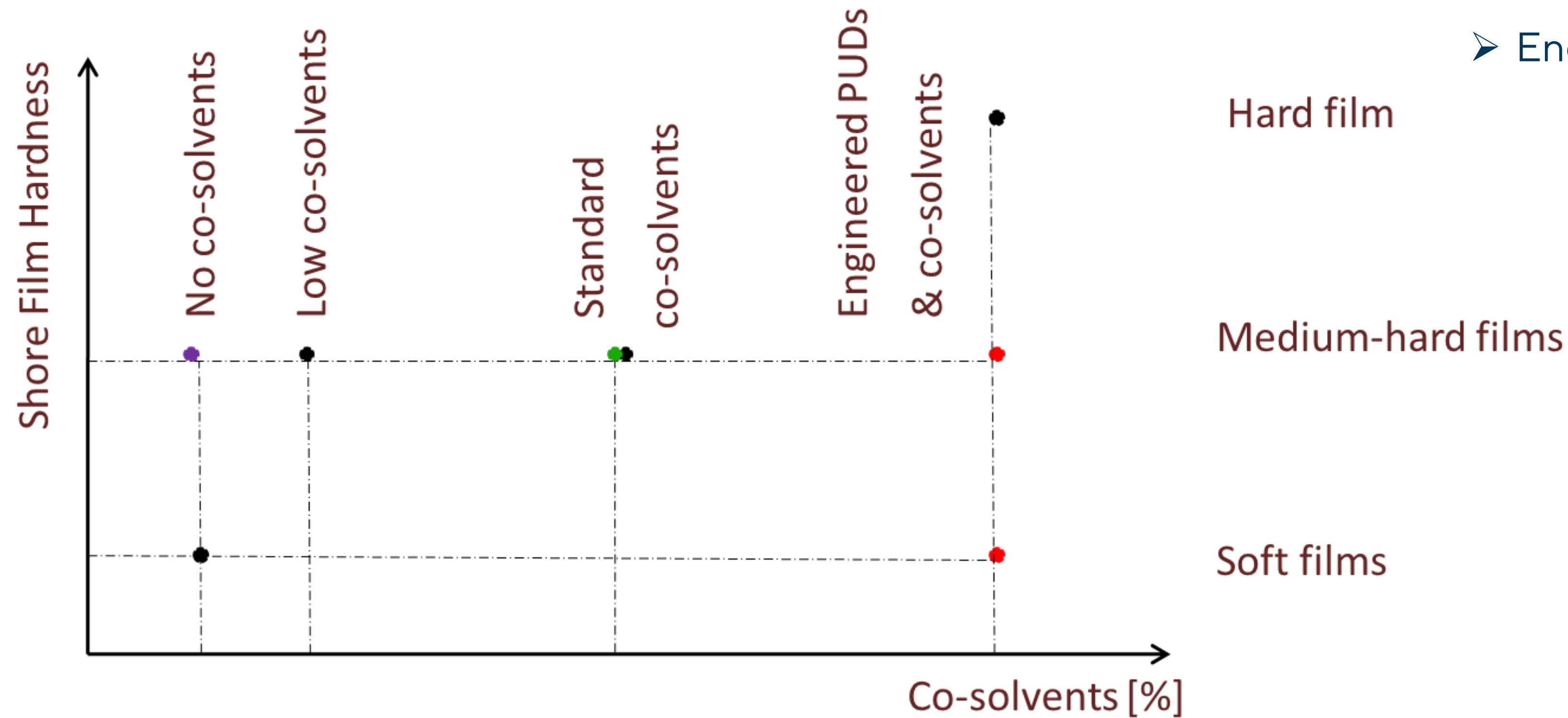




Samples selection

Samples have been selected considering following parameters:

- Film hardness
- Co-solvents
- Neutralizing agents
- Engineered monomers



Samples preparation

- Selected PUDs are all products available (or previously available) on the market, approved and regularly used at least by one banknote paper producer
- All PUDs have been diluted to 30% dry content
- All PUDs have been crosslinked with 4% free isocyanate crosslinkers (as received on as received) for enhancing wet abrasion and chemical resistance
- A 82 g/m² security base paper (previously sized with PVOH) has been used
- 5 g/m² dry of every PUD has been applied on each side
- Applications have been performed using a K101 Laboratory rod coater
- Samples have been dried 85 °C for 5' and conditioned for 24 hours at 25 °C and 50% HR

Test description

- Mechanical performance:
 - tesile strenght
 - double fold
 - burst

- Water hold out:
 - COBB₆₀

- Grease hold out:
 - TAPPI T-559
 - dynamic contact angle

- Weathering resistance:
 - ink adhesion



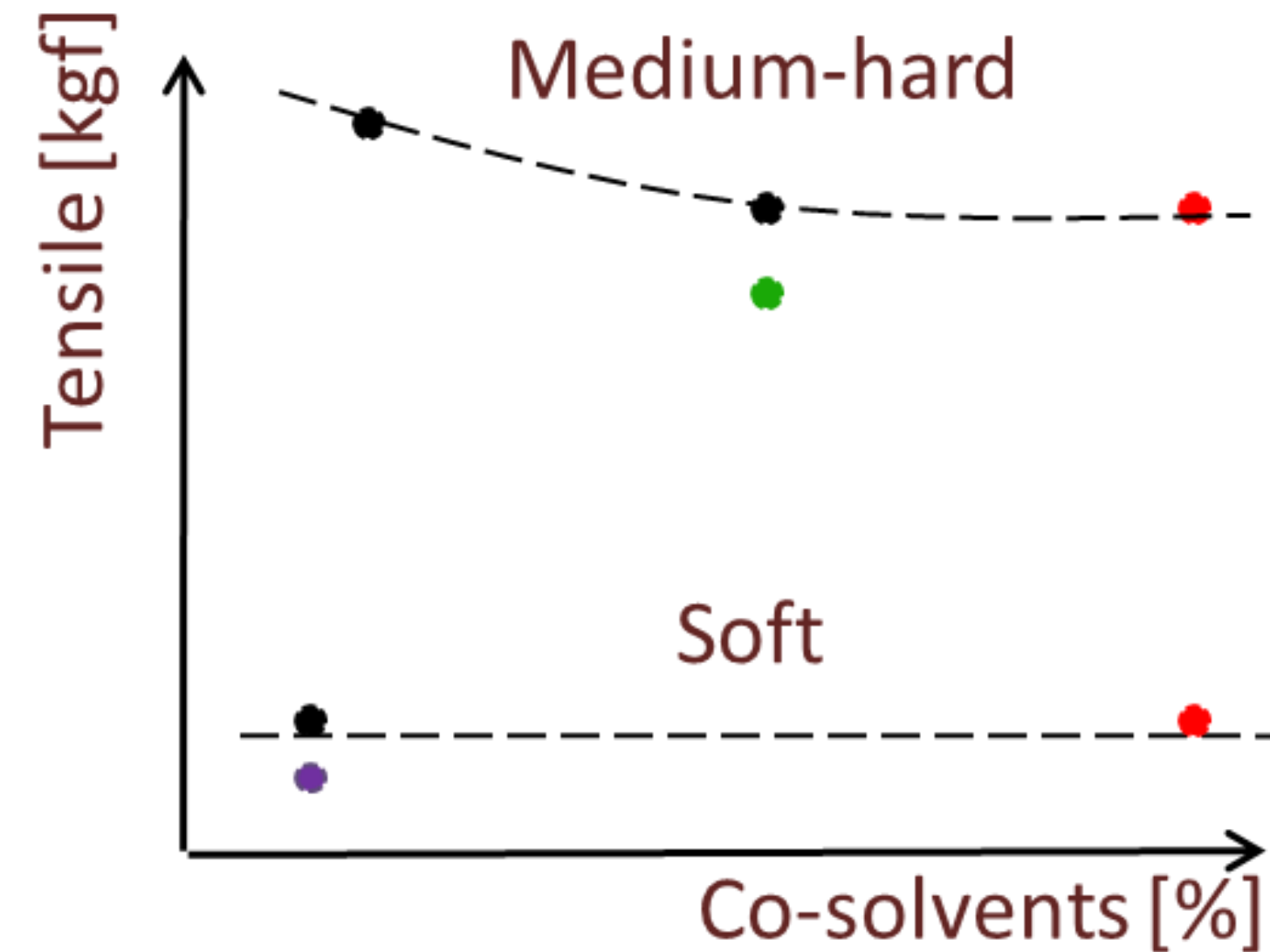
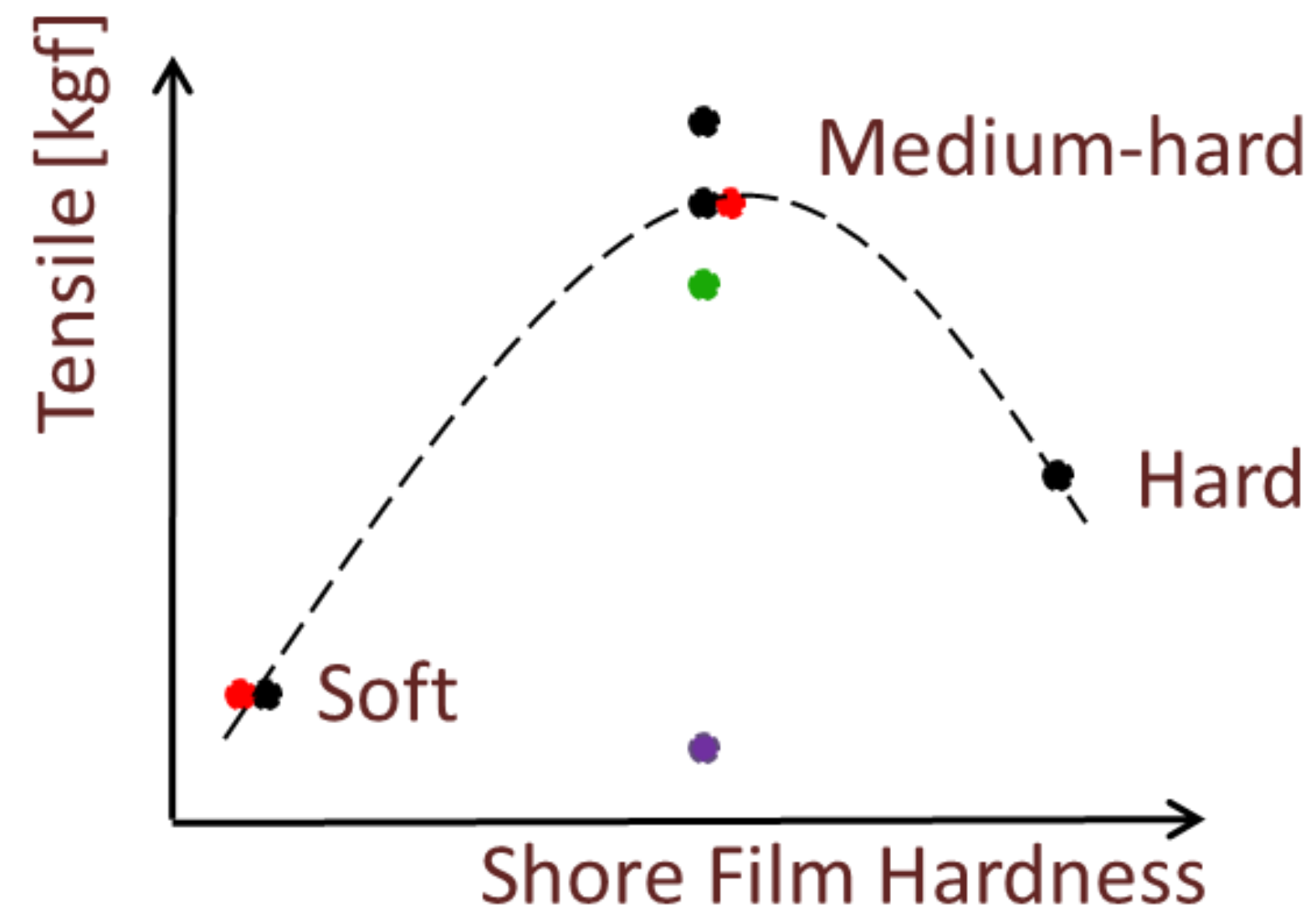
Results

Chemical structure – performance correlation



Tensile strenght

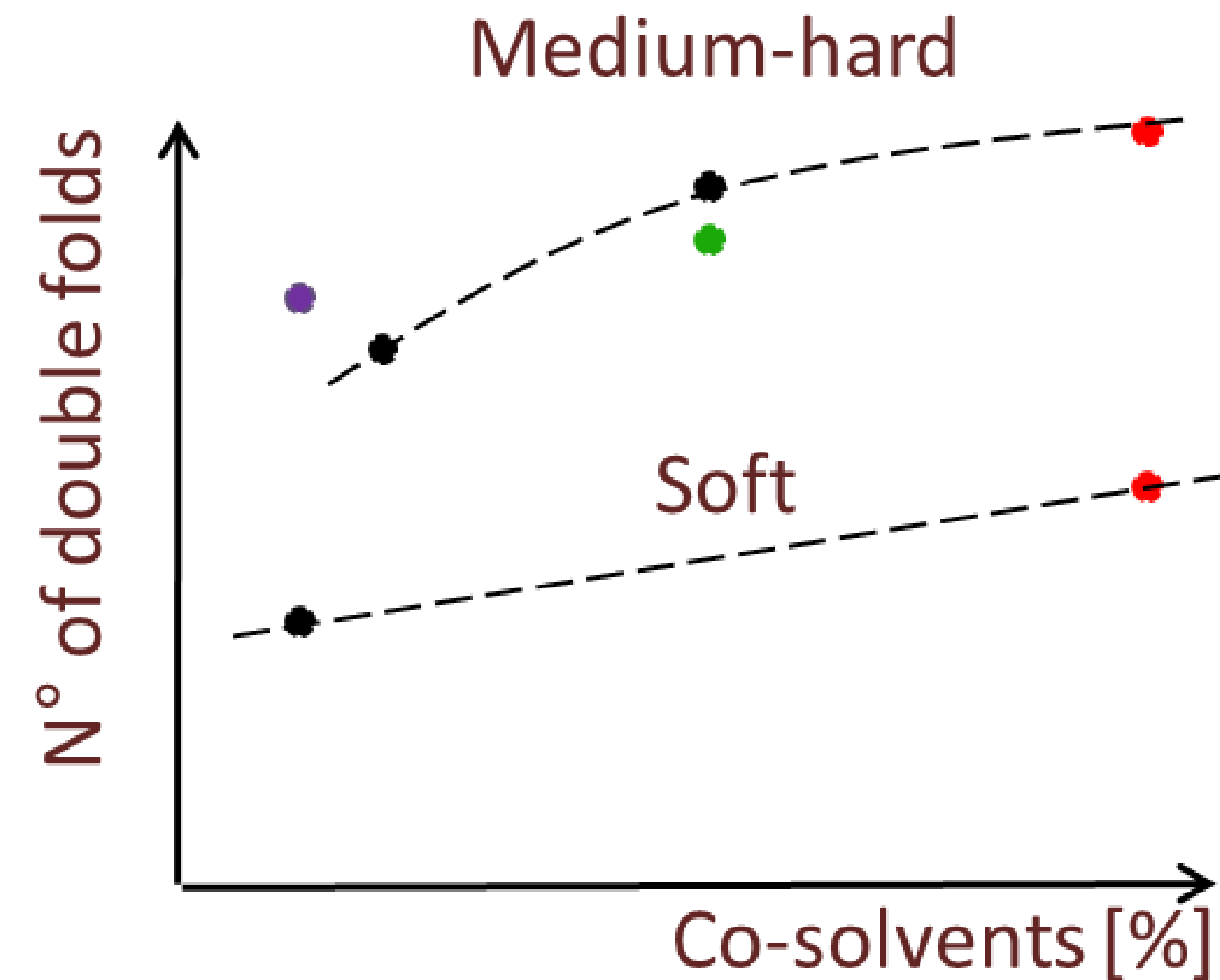
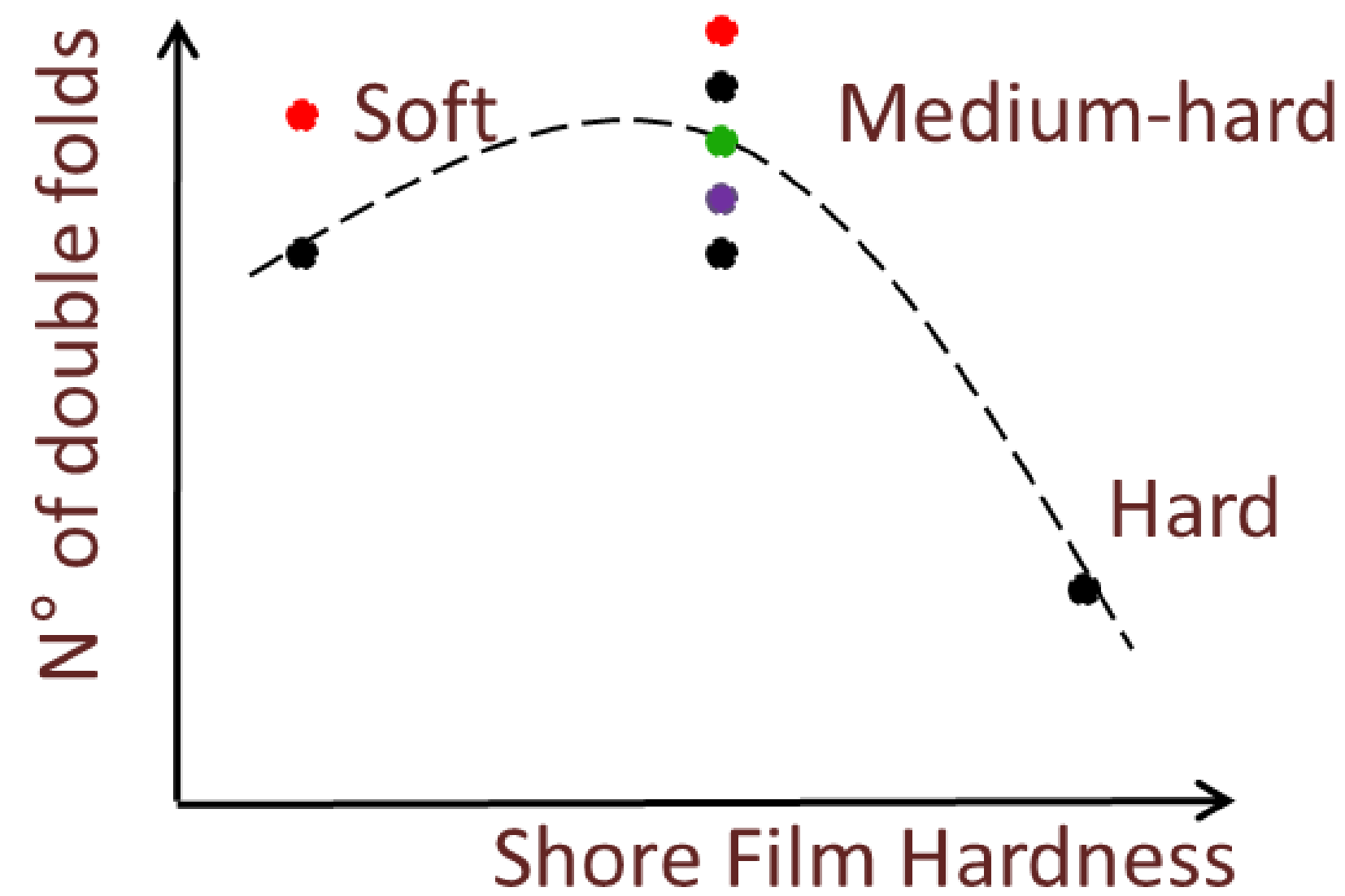
- Standard PUD with volatile neutralizing agent
- Engineered PUD with volatile neutralizing agent
- Standard PUD with non volatile neutralizing agent
- VOC Free PUD with non volatile neutralizing agent





Double fold

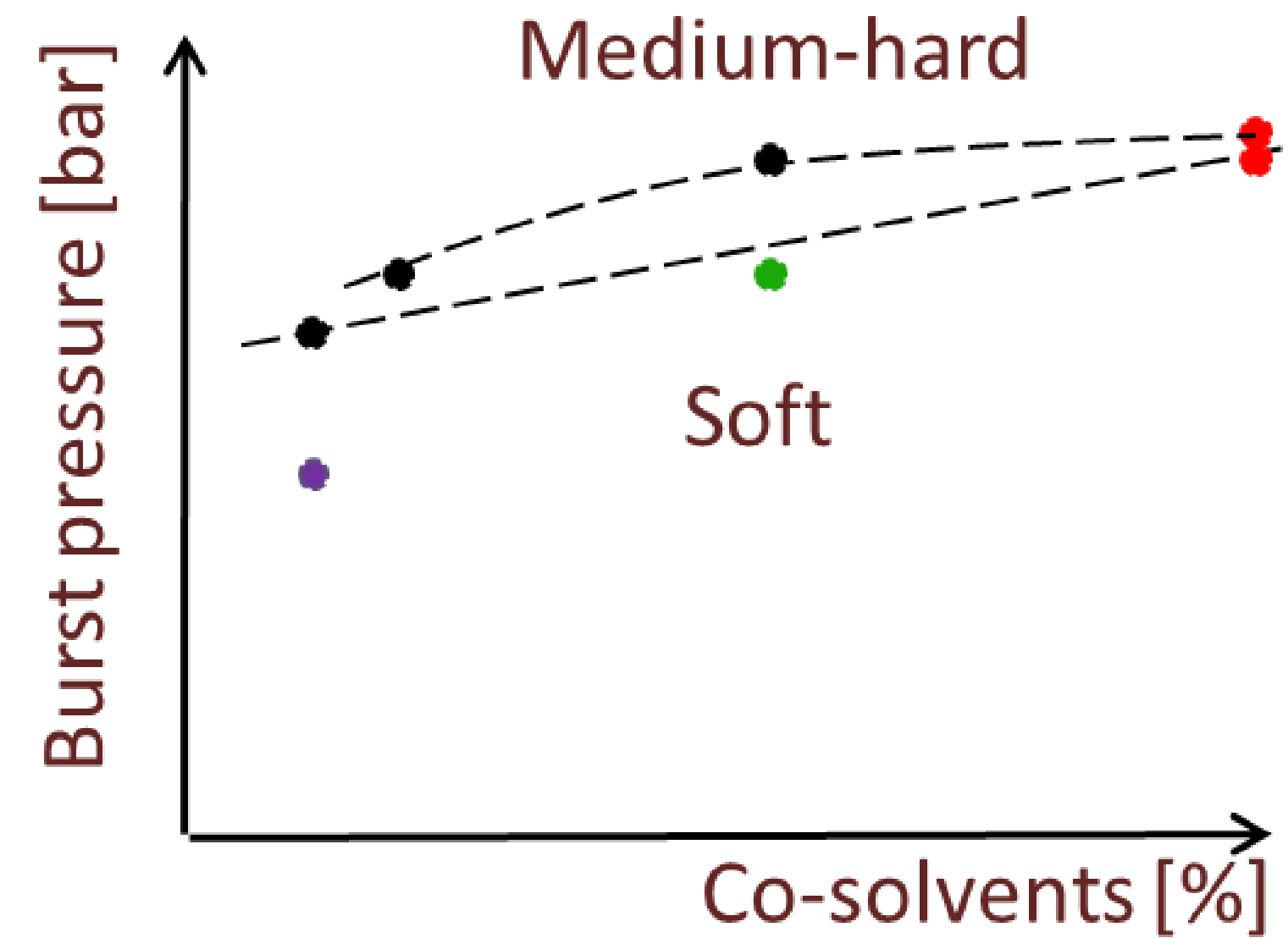
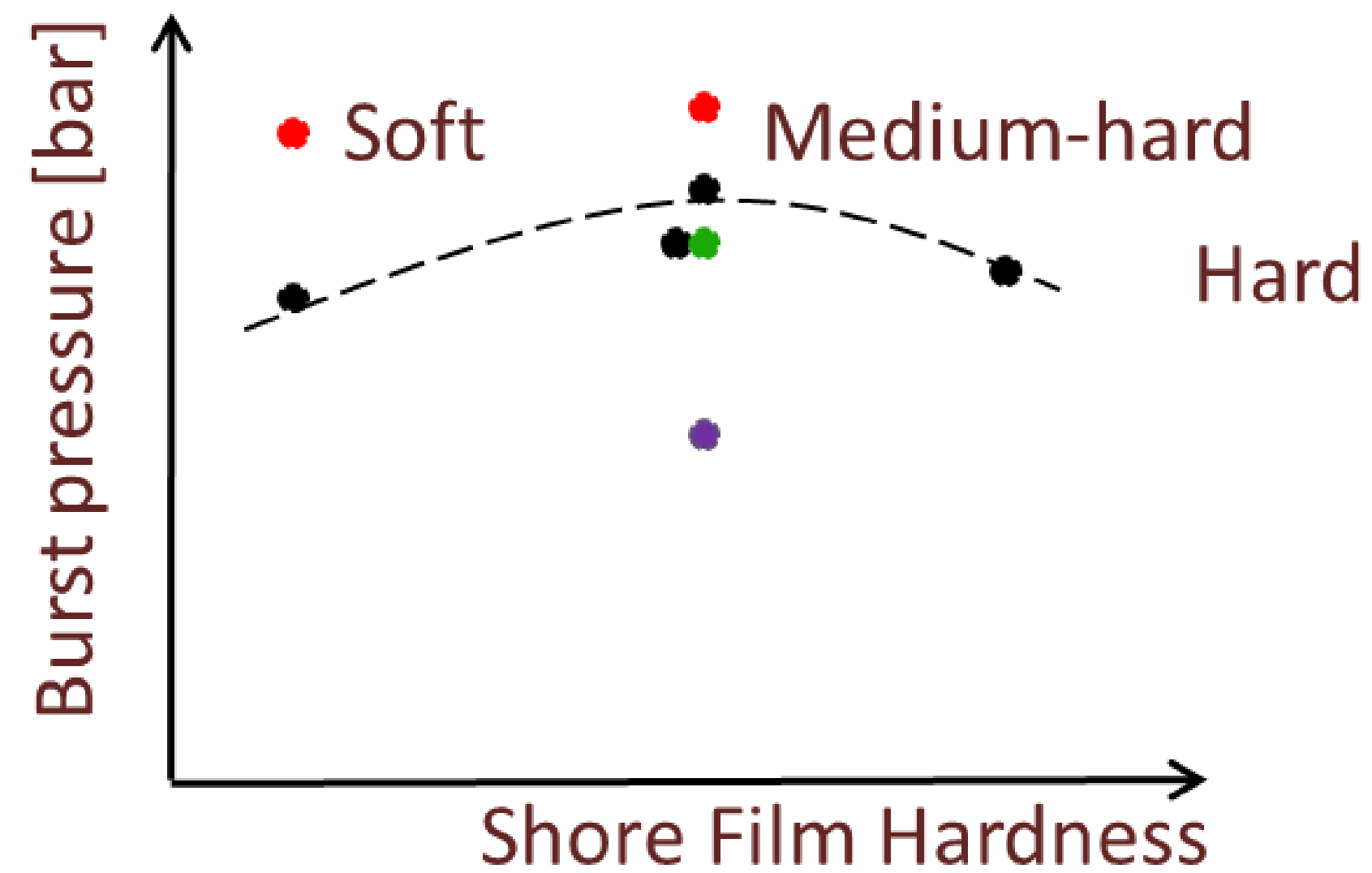
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Burst

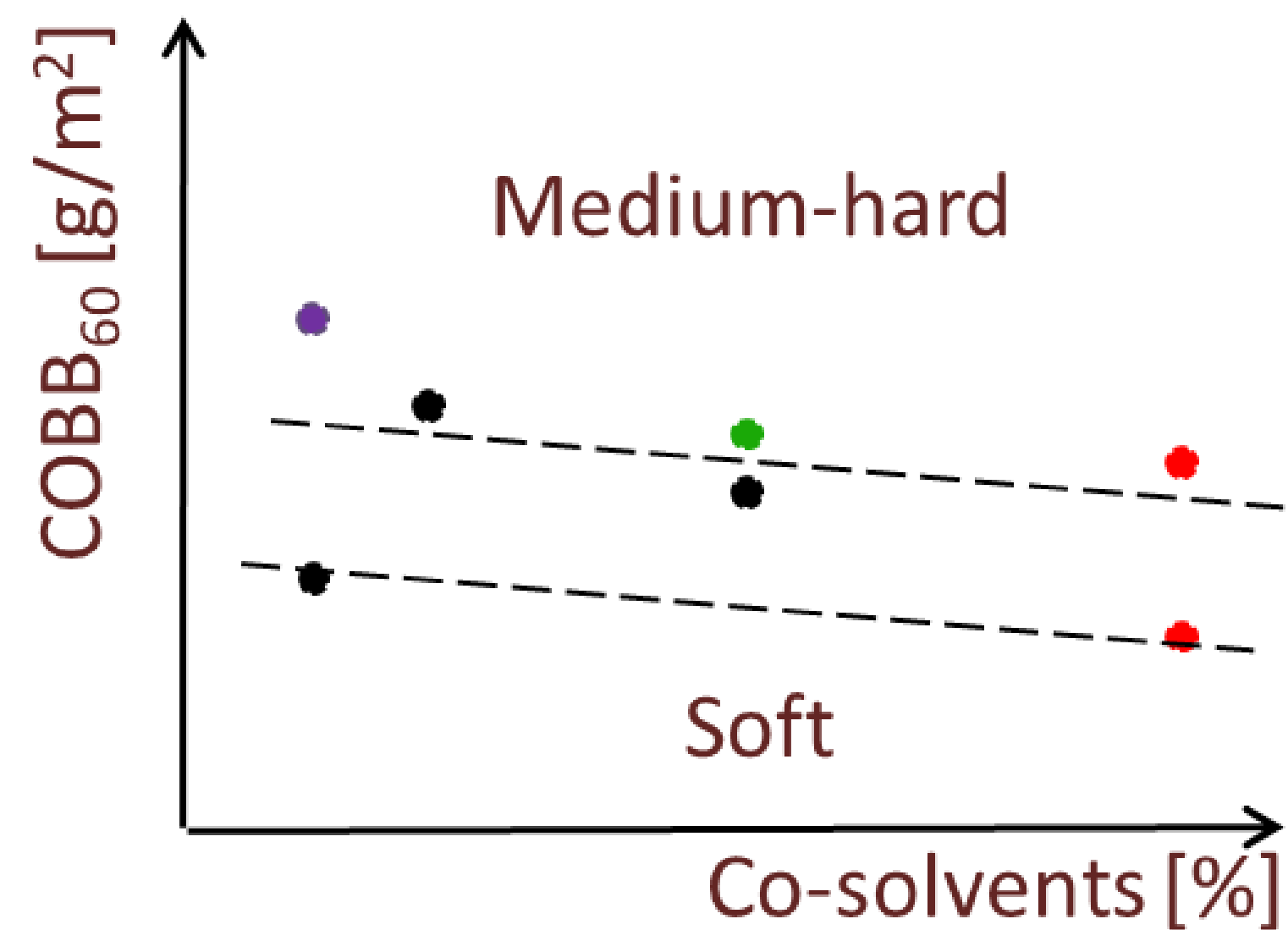
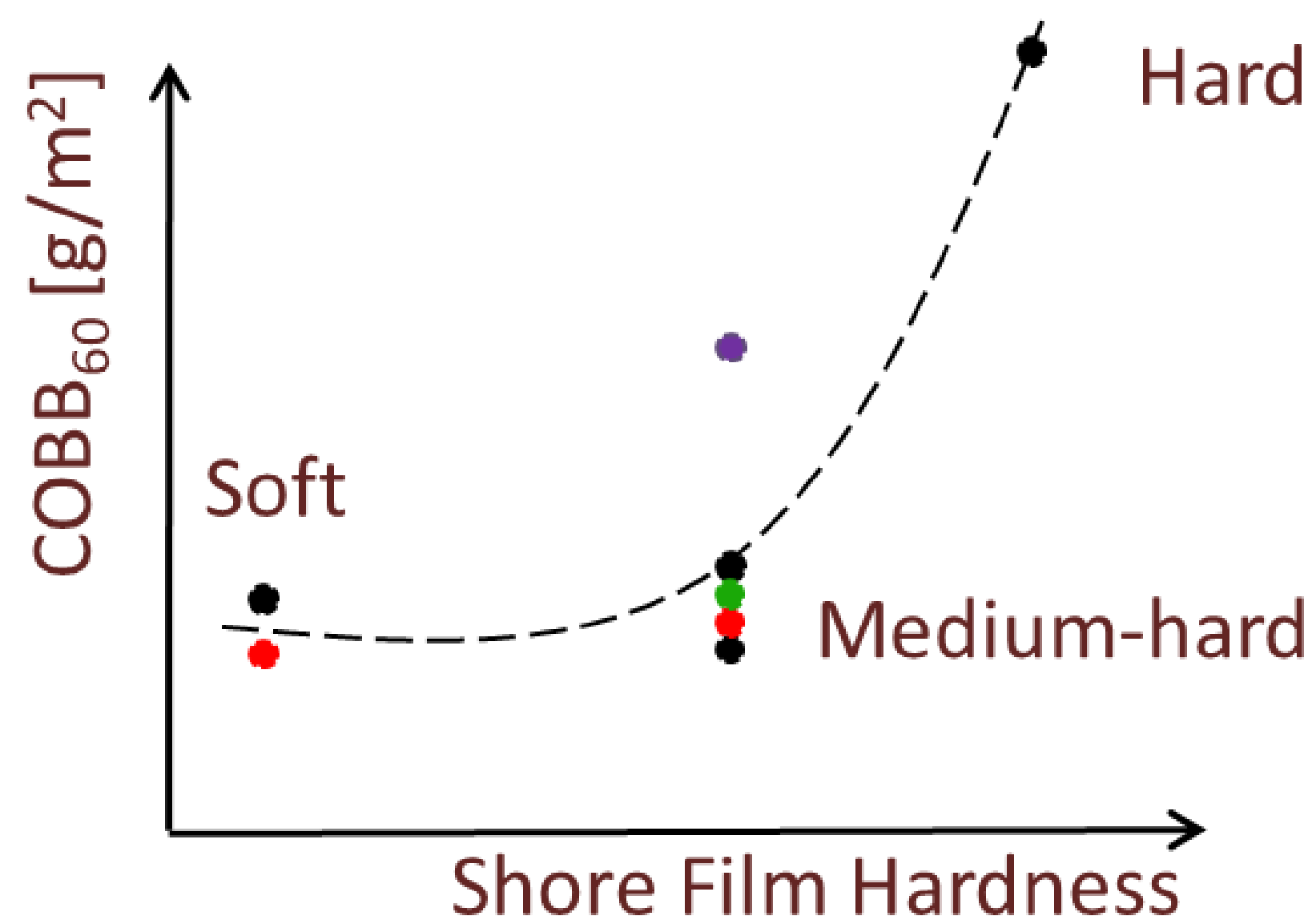
- Standard PUD with volatile neutralizing agent
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- Standard PUD with non volatile neutralizing agent
- VOC Free PUD with non volatile neutralizing agent





Water hold out

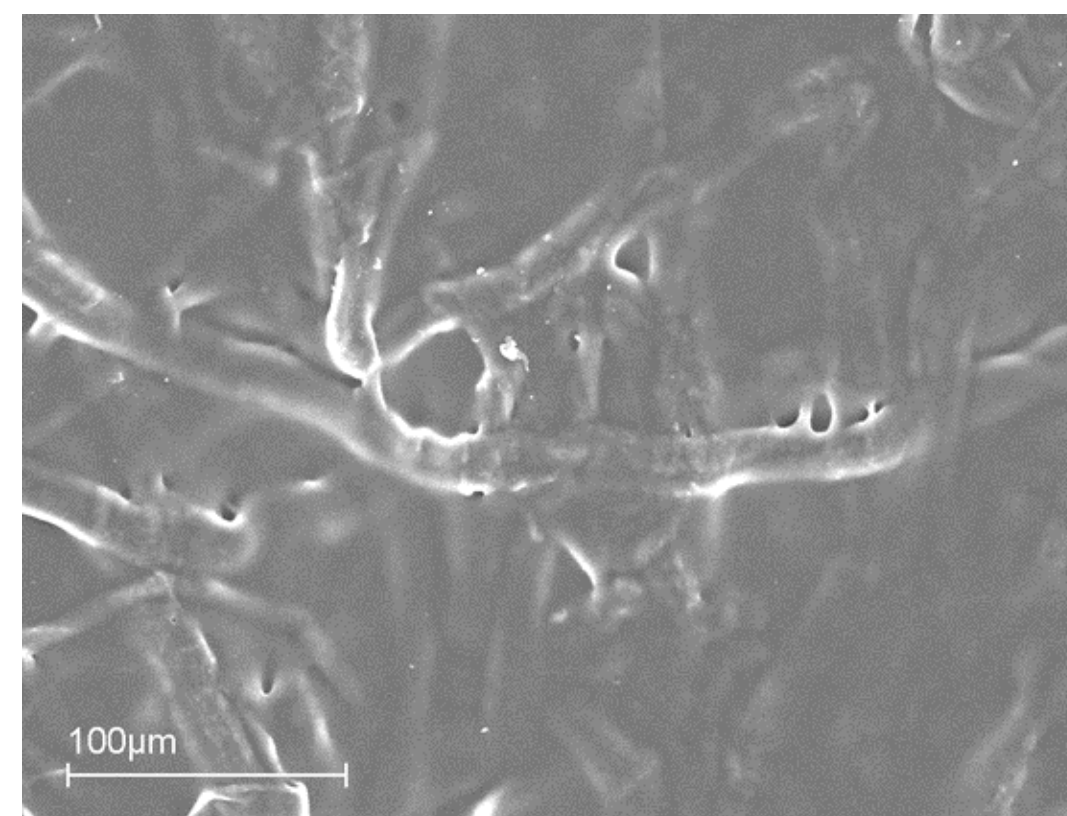
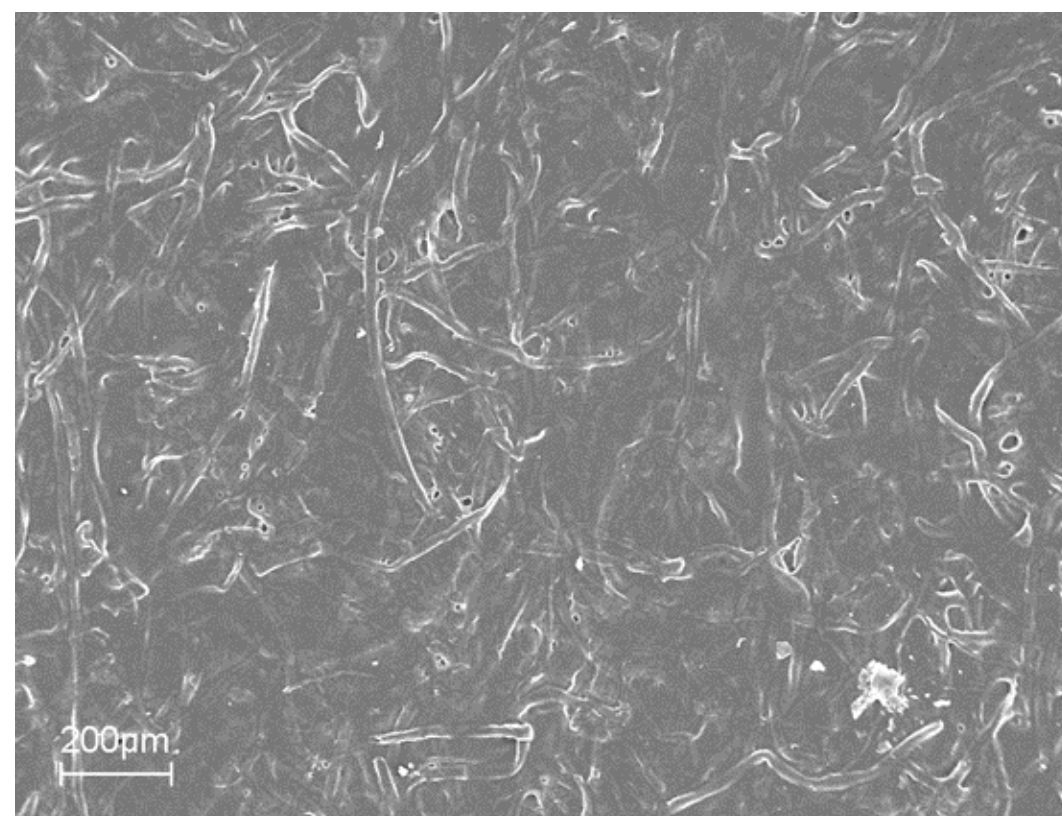
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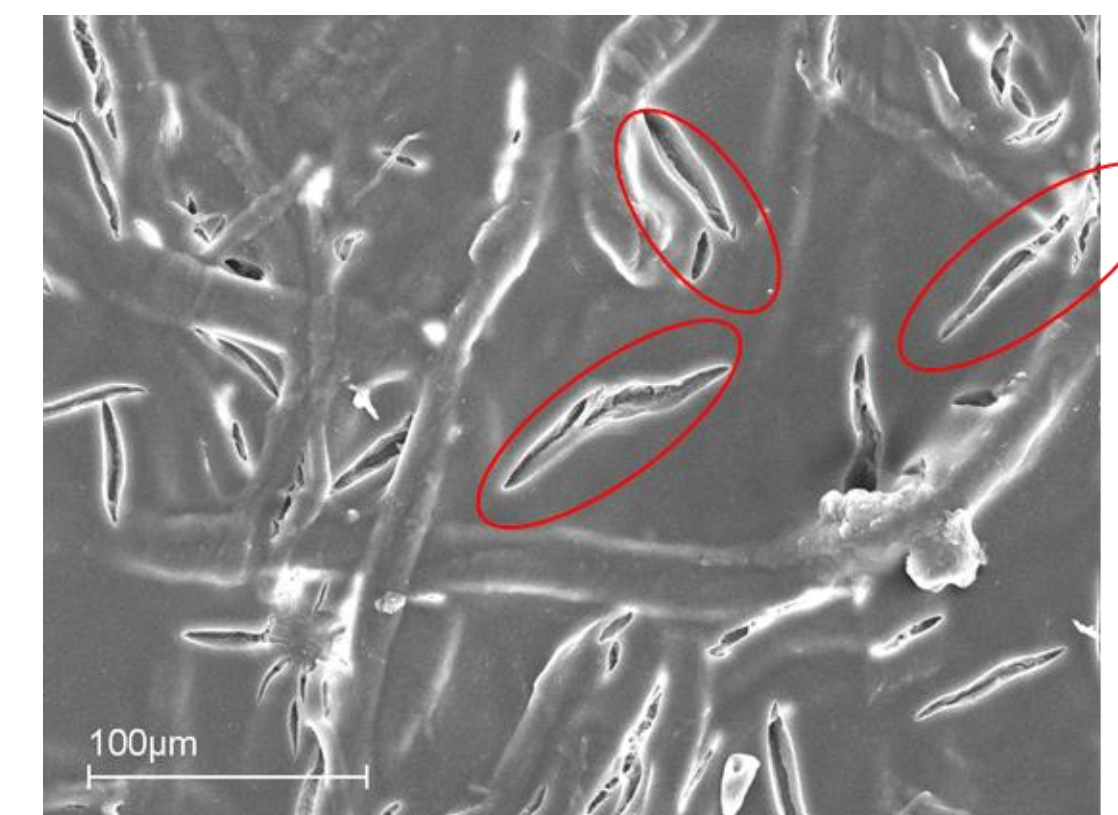
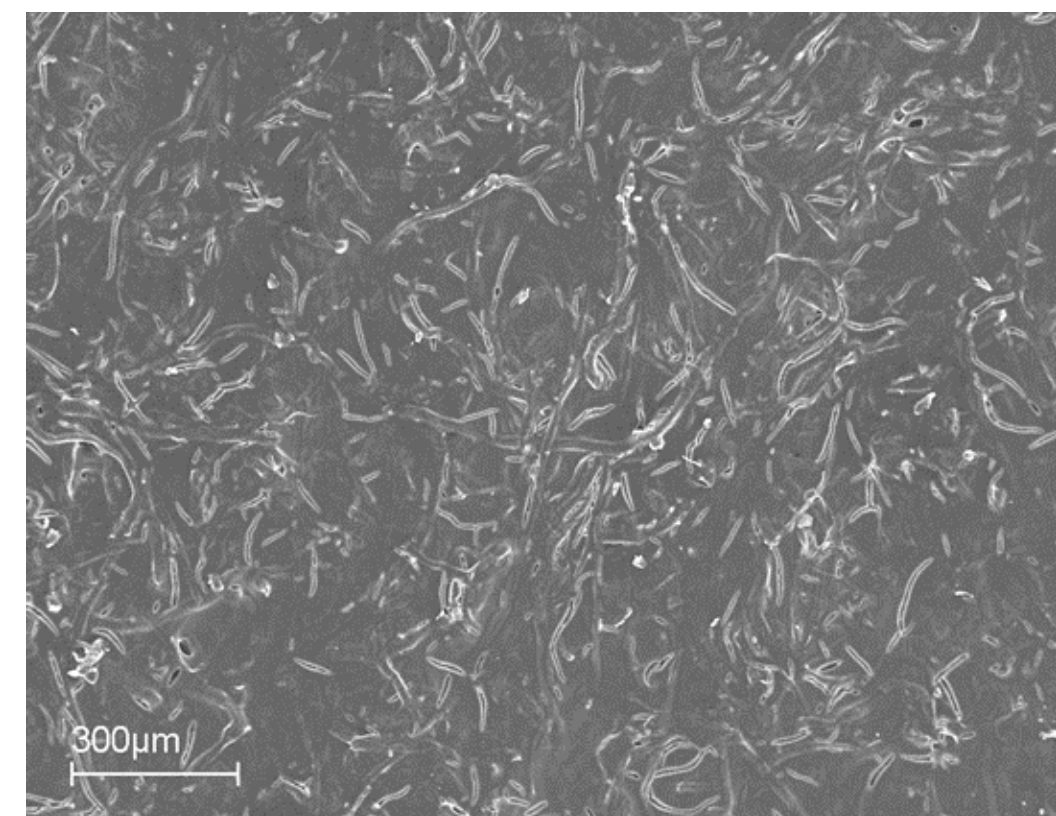


Water hold out – SEM analysis

Soft film



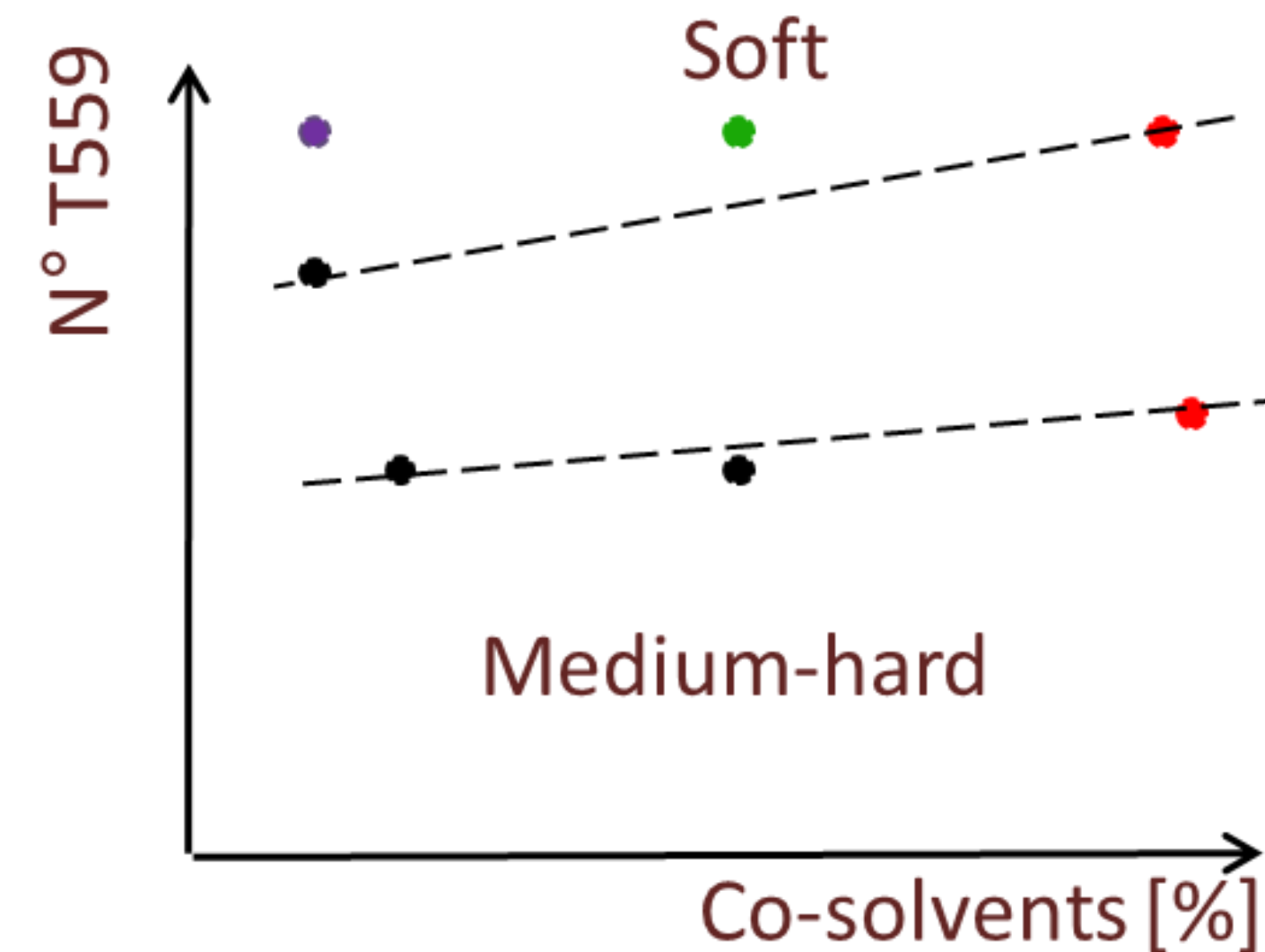
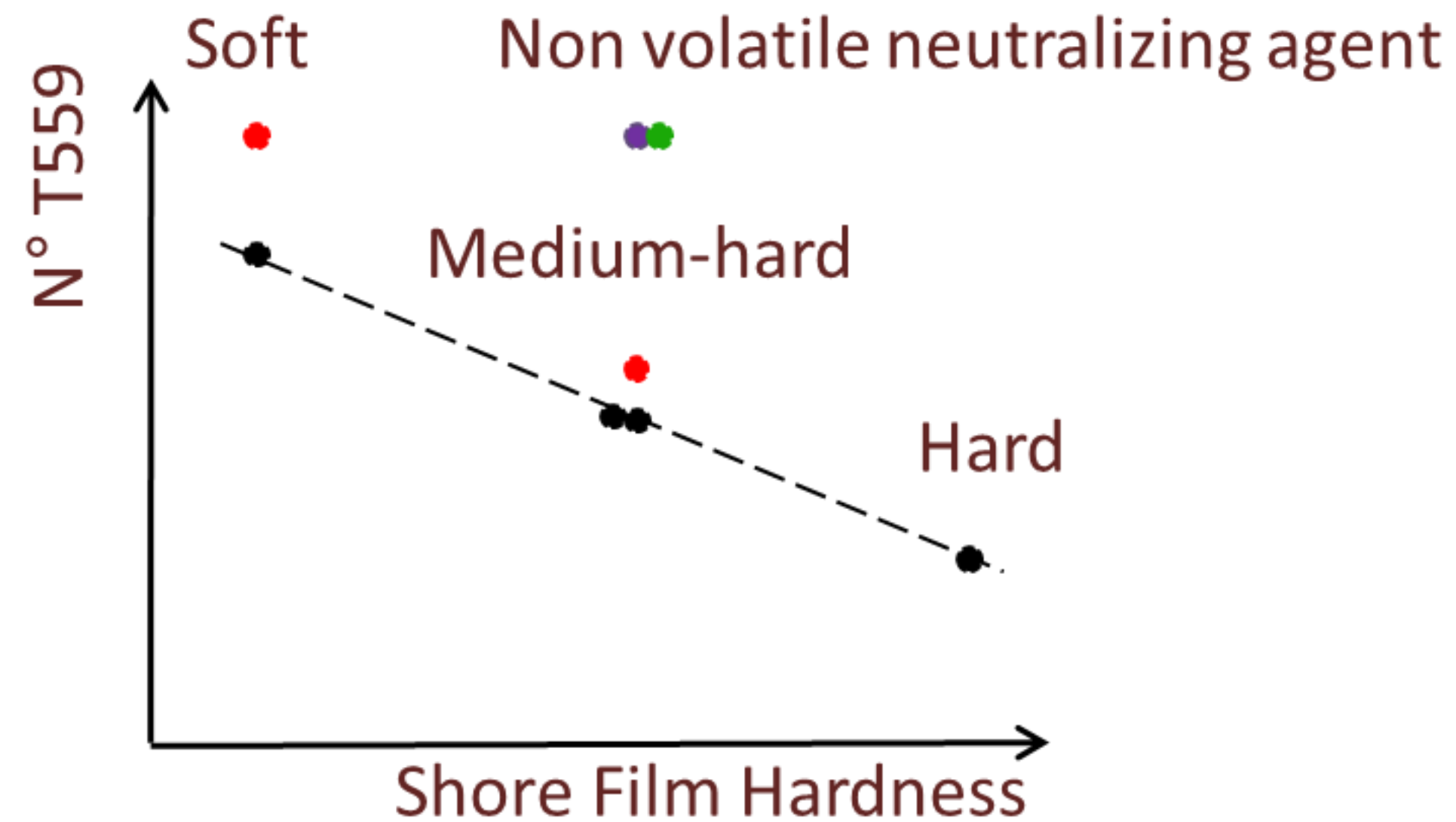
Hard film





Grease hold out

- Standard PUD with volatile neutralizing agent
- Engineered PUD with volatile neutralizing agent
- Standard PUD with non volatile neutralizing agent
- VOC Free PUD with non volatile neutralizing agent



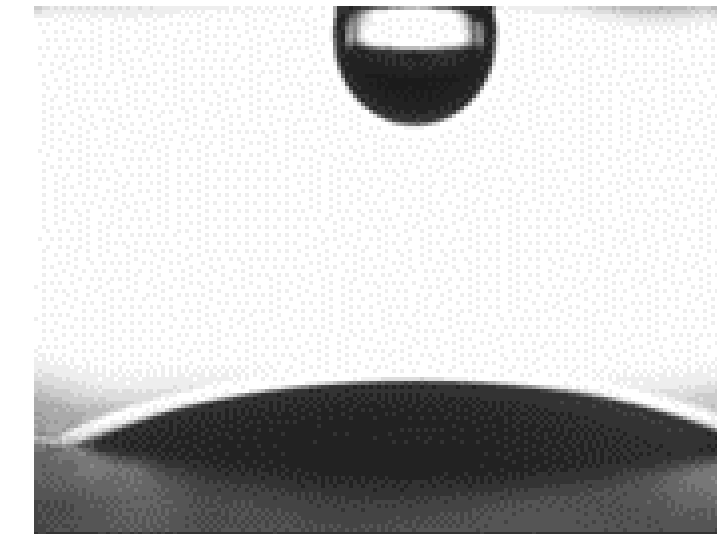
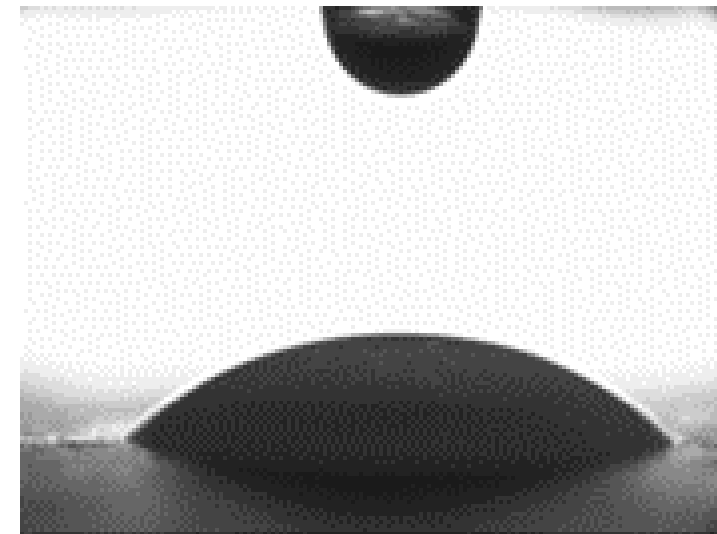


Grease hold out – Contact angle

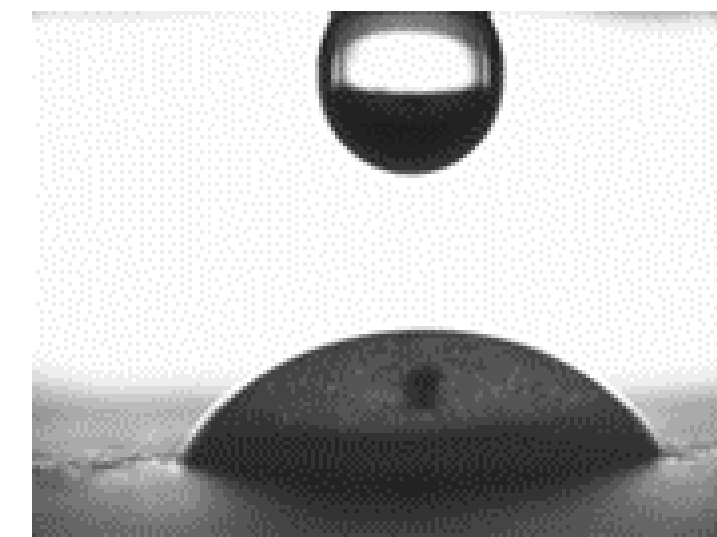
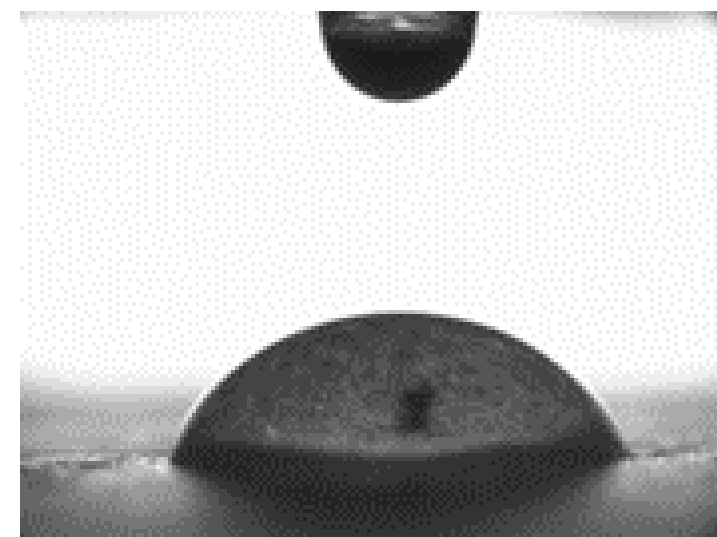
Starting angle

Final angle

Traditional PUD



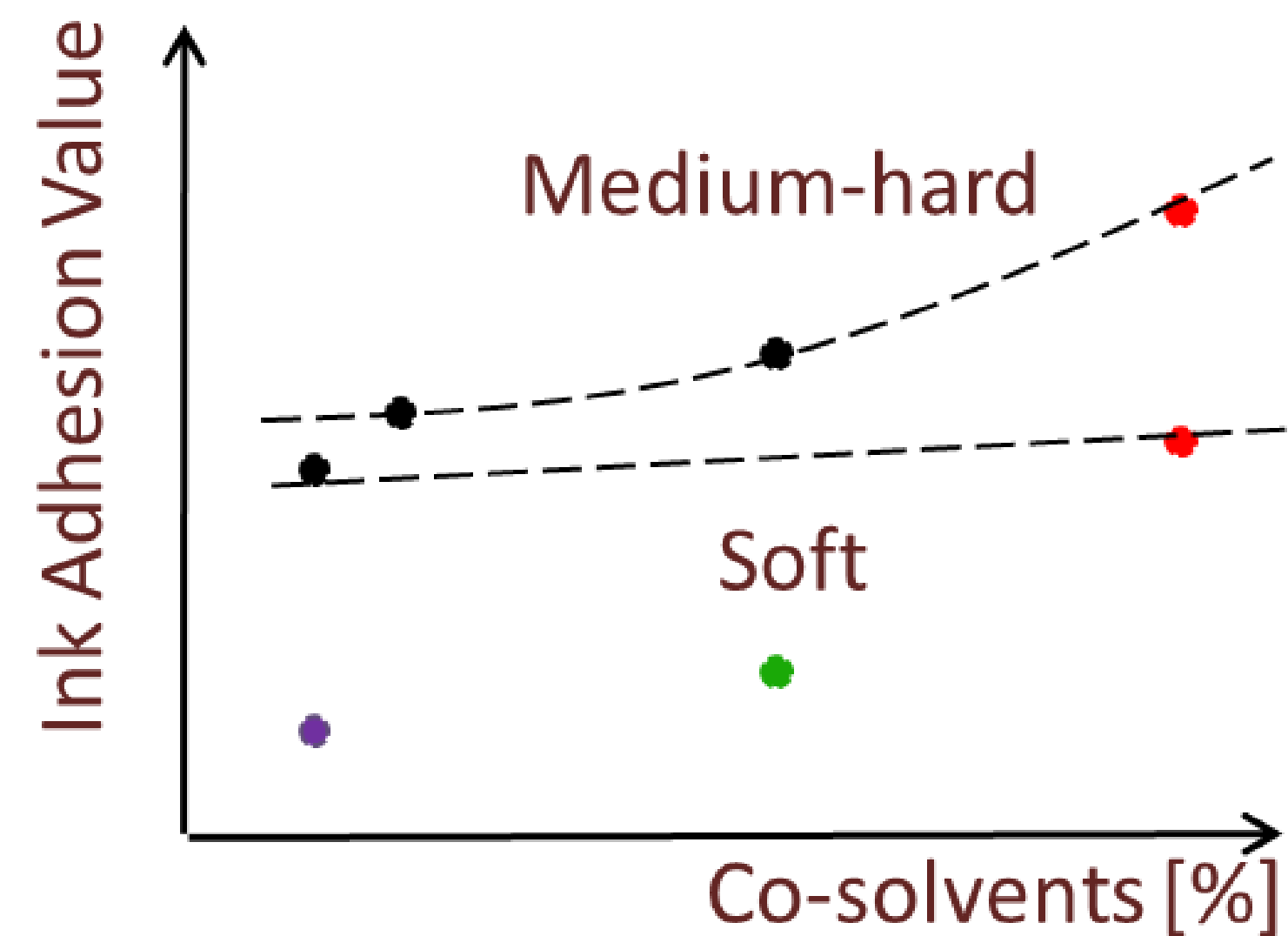
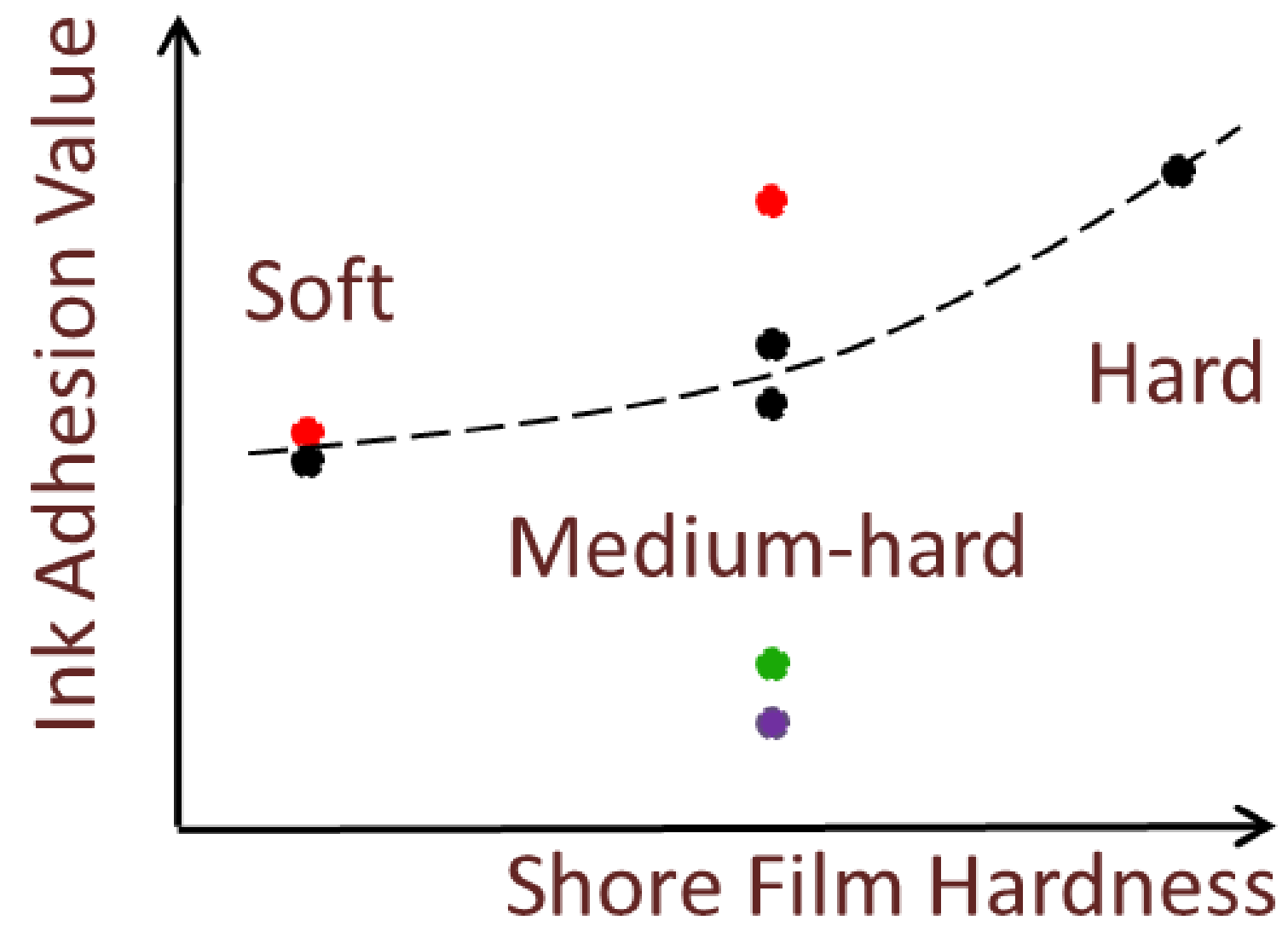
Antisoil PUD





Ink adhesion

- Standard PUD with volatile neutralizing agent
- Engineered PUD with volatile neutralizing agent
- Standard PUD with non volatile neutralizing agent
- VOC Free PUD with non volatile neutralizing agent



Conclusions

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Conclusions

- There is no «one fits all» product that could fulfill every different requirement
- Depending on performance, application method, HSE evaluations, it is possible to find a solution for every need
- We have deep knowledge about PUD and long experience in surface treatment for banknote paper
- Our ESACOTE® range is able to meet the rising and challenging request coming from banknote paper market
- For any unmet need, we are available to discuss about developments and partnerships





The full article is available for download at:

<https://surfacetreatment.lamberti.com/markets/coated-and-functional-paper/functional-paper/Security-paper.html>

For further information you can write to:

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