European Polymer Dispersion and Latex Association

POSITION PAPER

December 2024

EPDLA's position paper on polymer dispersions, redispersible polymer powders made thereof and synthetic polymer microparticles

The European Polymer Dispersion and Latex Association (EPDLA), a Cefic Sector Group, is dedicated to promoting the safe manufacture, transportation, distribution, handling and use of waterborne polymer dispersions and redispersible polymer powders made thereof in compliance with regulatory requirements and industry guidelines.

EPDLA members are committed to Responsible Care® principles and have implemented risk management according to the precautionary principles.

On September 25, 2023 the European Commission published regulation (EC) No 2023/2055[1] amending Annex XVII to Regulation (EC) No 1907/2006 of the European Parliament and of the Council concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) as regards synthetic polymer microparticles (SPM). The present position paper will discuss how this regulation relates to polymer dispersions and redispersible polymer powders made thereof.

Polymer dispersions

Polymer dispersions are used as raw materials (binders) in many waterborne applications, for example in adhesives, varnishes and coatings, printing inks, non-wovens, paper and paperboard textile finishing agents and redispersible polymer powders. Polymer dispersion technology has been used safely and successfully for more than 70 years and has contributed significantly to a reduction in the release of organic solvents into the environment. The use of polymer dispersions has helped to reduce the use of organic solvents in workplaces leading to improved worker health and similarly has contributed to cleaner air in the home, to an extension of the service life of many materials e.g. via surface protection, and efficient, durable and sustainable construction e.g. via contribution to insulation of buildings. Common to all dispersions and covered by this position paper, is a film forming process during application.

Polymer dispersions are mixtures as defined under Article 3(2) of the REACH Regulation[2], consisting mainly of water and droplets containing high molecular weight polymers. Based on polymer weight and chemical nature, the polymer droplets are typically highly viscous. The size of such polymer

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[1] Regulation - 2023/2055 - EN - EUR-Lex (europa.eu)

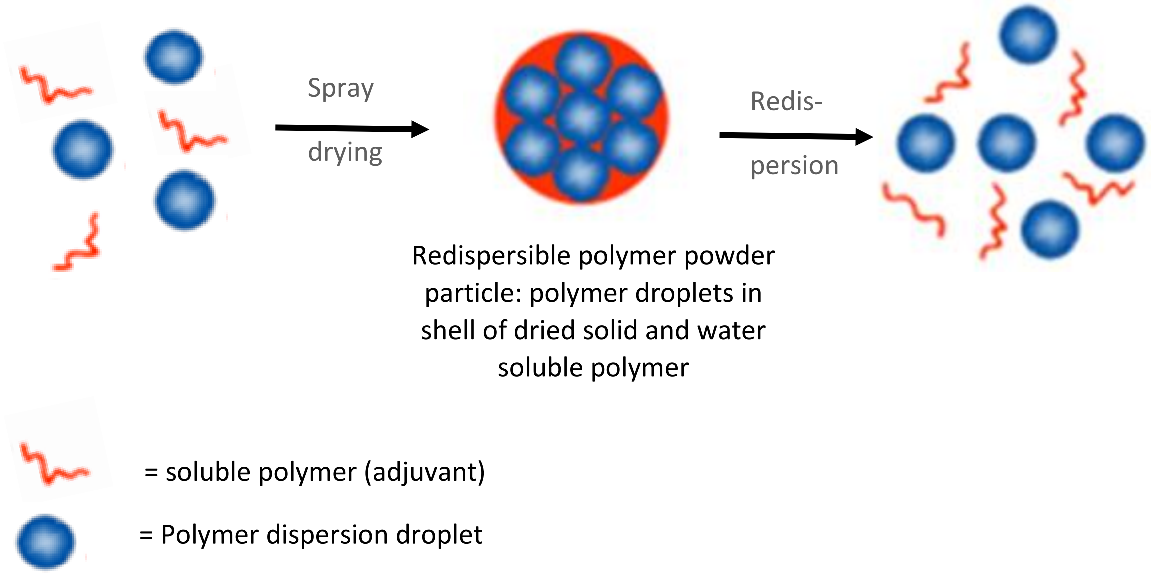
[2] Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC

containing droplets can widely vary between ca. <100 nm (<0.1 µm) and 10,000 nm (10 µm) in diameter[3]. For more details on the status of polymer dispersions with respect to nanomaterials, please refer to the EPDLA position paper on nanomaterials[4].

Within a polymer dispersion, the polymer droplets are dispersed and stabilised in water and regarded as embedded in the liquid matrix. They cannot be isolated as discrete droplets or particles by simple separation techniques and do not exist without their waterborne environment. Their fate is to form a film e.g. as an adhesive or paint.
As the water in the mixture evaporates, the polymer droplets approach and touch each other and when above (initial) melting temperature fuse together which leads to the film formation via coalescence of the polymer droplets[5].
Human or environmental exposure to individual polymer droplets is thus not expected under advised conditions of use.

Redispersible polymer powders

Redispersible polymer powders (RDP) are obtained through spray-drying of polymer dispersions with the help of a spray drying adjuvant polymer. Such spray drying adjuvant polymers are solid and water soluble polymers. During spray drying larger particles in the micrometer range, typically >>1 µm are formed as loose agglomerates of a few polymer dispersion droplets individually covered by the spray drying adjuvant polymer.



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[3] nm = nanometer / µm = micrometer

[4] EPDLA position paper on polymer dispersions and nanomaterials (updated December 2024)

[5] (469) EPDLA Sector Group of Cefic - YouTube

The RDPs are usually free-flowing fine powders, with a particle-size distribution in the micrometer-range. Moreover, the RDPs contain a sort of liquid core (the original dispersion polymer droplets) in a shell of a dried solid and water soluble polymer (optionally containing inorganic material).

In contact with water, the redispersible polymer powder particles disappear as the shell of soluble polymer dissolves and releases the individual dispersion droplets in their original state again. This redispersed polymer droplet has the same properties as the original polymer dispersion droplet.

Due to their decisive influence on cement, lime or gypsum based finished drymix mortar products, as well as on cement free and mineral-binder free systems, redispersible polymer powders are mainly used as building material additives in construction-applications to provide e.g. adhesion to many types of surfaces and substrates, flexibility or waterproofing.

Polymer Dispersions and synthetic polymer microparticles (SPM)

According to the regulation SPMs are *polymers that are solid and which either:*

> *(a) are contained in particles and constitute at least 1 % by weight of those particles, or*
> *(b) build a continuous surface coating on particles.*

The regulation defines liquids as follows:

> *(i) the substance or mixture at 50 °C has a vapour pressure of not more than 300 kPa, is not completely gaseous at 20 °C and at a standard pressure of 101,3 kPa, and has a melting point or initial melting point of 20 °C or less at a standard pressure of 101,3 kPa.*

EPDLA has concerns around the methods available for assessing whether in water dispersed polymeric matter is liquid or solid and falls under the definition of SPM.

EPDLA suggests using the Minimum Film Formation Temperature (MFFT)/White point (WPT), which is a common industrial ISO standard method, to measure the initial melting point of the polymer in a polymer dispersion.

The two other test methods mentioned in Annex No. 2. (d) of regulation (EC) No 2023/2055 for assessing the state of matter are not applicable to polymer dispersions. ASTM D 4359-00 or the penetrometer test can only be applied to bulk polymers. Since polymer dispersions are always placed on the market in a homogeneous liquid water phase, their state of matter cannot be assessed using these methods. Therefore, other methods are needed to determine if polymeric matter dispersed in water is liquid or solid and falls under the definition of SPM.
The polymers of a typical polymer dispersion are produced directly in a liquid medium, which is in most cases water. Since polymerization is initiated directly in the liquid medium, there is an extreme interaction of the hydrophilic part of the polymer with the dispersing medium (mostly water). There is no separation of the finished polymer from the dispersion medium and the polymer remains

dispersed and stabilised in water by hydrophilic polymers and/or surfactants and has to be regarded as embedded in the water matrix**.**

When the dispersion is applied on a surface (as coating, adhesive or other) the water starts to evaporate, and the polymer droplets move together until they touch each other. When the polymer is above its initial melting point temperature, the droplets start to fuse together upon further removal of the water and finally form a clear film. The fusion of droplets is called coalescence and is the initial melting point of dispersed polymer matter[5]

Therefore, film forming polymer dispersions with a MFFT or WPT equal to or below 20°C do not fall under the SPM definition. The fact, that an opaque thin layer changes into a transparent film is another proof of changing the state of matter from solid (below WPT) to the presence of liquid material above WPT. Therefore, the WPT characterizes the initial melting point of the dispersion polymer.

Any crosslinked or very high molecular weight polymer molecules are diffusely (no interface) distributed within the droplets. The outer shell of droplets consists typically of polymer molecules in the lower molecular weight range which are more hydrophilic. These lower molecular weight polymers interact strongly with the typically present emulsifier to stabilize the droplets in water. Thus, most polymer dispersions will not be SPM, because the polymer droplets are not considered solid.

The above clarifications apply both to individual substances and mixtures where dispersion polymer droplets may be present at a concentration ≥ 0.01% w/w, such as, for example, in adhesives or paints.

Most polymer dispersions have a WPT/MFFT ≤ 20°C and therefore cannot be considered SPM; conversely, polymer dispersions with a WPT/MFFT above 20°C could be considered SPM.[6]

For these cases, however, derogations will apply, as described in the following: Applications of polymer dispersions involve the formation of a film.

Film formation is critically dependent on the minimum film forming temperature (MFFT) /white point of the polymer dispersion, which is the lowest temperature at which a thin layer of a polymer dispersion will still dry to form a coherent film. This white point temperature is therefore equal to the initial melting point temperature of the film forming polymer in the dispersion product as defined in Annex XVII of the regulation under point 2d(i).

Both MFFT and white point can be measured according to the DIN ISO 2115 standard. The minimum film forming temperature (MFFT) is a widely used and extremely important application relevant property of polymer dispersions (see above) and has been used by industry for many years. The white point temperature (WPT) or initial melting point describes much better the coalescence temperature of polymer dispersions droplets and should therefore be used for the determination of the initial melting point of the film forming polymer in dispersions.

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[6] Even with high-MFFT polymers, coalescence can be forced by adding so called coalescence agents. This is typically done by downstream users, e.g. paint manufacturers.

We ran an anonymized Round Robin (RR) or Ring Test between EPDLA members to validate the MFFT method as industrial standard. The standard deviation of <1.5°C that was finally achieved in the RR substantiates the accuracy and practicability of the MFFT method as industrial standard. Details of this round robin test can be found in Annex I, and will be published in European Coatings Journal (ECJ 1-2/2025).

Paragraphs 4 and 5 of the draft synthetic polymer microparticle restriction provide derogations for the placing on the market of SPM or mixtures containing such microparticles if:

- they are used at industrial sites,
- or if the resulting film does not meet the definition of a synthetic polymer microparticle,
- or if the microparticles are permanently incorporated into a solid matrix at the time of use,
- or if the microparticle is contained by technical means so that no release to environment can occur.

We therefore understand that the use of polymer dispersions for most applications will not be impacted by the restriction for placing on the market under this regulatory proposal. However, the European Commission foresees **labelling and reporting requirements for uses of those dispersions which contain solid polymers above 0.01%,** which comprise among others:
Suppliers of aforementioned derogated products containing SPMs shall provide instructions for use and disposal to avoid releases of SPMs to the environment as well as information on quantity or, as applicable, concentration of SPMs in the substance or mixture.

Redispersible polymer powders and synthetic polymer microparticles

The RDPs are usually free-flowing fine powders, with a particle-size distribution in the micrometer-range. The RDP particles consist of the original polymer droplets of a dispersion covered by a shell of a dried and water-soluble polymer. They are a mixture of two polymers, the spray drying adjuvant polymer and the dispersion polymer.
Since the spray drying adjuvant polymer has a solubility of much greater than 2g/l, it is excluded from the restriction. The second polymer coming from a dispersion is not considered as SPM if the initial melting point is equal to or below 20°C (typically measured via MFFT/WPT method). Therefore, in most cases redispersible polymer powders do not fall under the SPM definition. When the redispersible polymer powder is dispersed in water the individual dispersion droplets are released in their original state again and don't fall under the SPM definition if the MFFT or White Point Temperature is below 20°C.

Are redispersible polymer powders concerned by ‘Operation Clean Sweep’ or the proposed Regulation of the European Parliament and of the Council on preventing plastic pellet losses to reduce microplastic pollution?

Operation Clean Sweep (OCS[7]) is a voluntary industry initiative to minimize plastic pellet loss. The term pellet covers either resin pellets, flake or polymer *powders*. However, the powders covered by OCS are meant for the manufacturing of plastic, whereas redispersible polymer powders go into totally different applications like for example in concrete or mortar formulations. Furthermore, the outer shell of such RDPs is soluble and the “inner core” contains polymer droplets.
This pellet definition of Operation Clean Sweep contrasts the Proposal for a Regulation of the European Parliament and of the Council on preventing plastic pellet losses to reduce microplastic pollution COM(2023) 645[8], where “plastic pellet” means a small mass of preformed polymer-containing moulding material, having relatively uniform dimensions in a given lot, regardless of its shape, form or size, that is used as feedstock in plastic product manufacturing operations
Latter definition clearly does not comprise redispersible polymer powders, as they are not intended for molding or plastic product manufacturing.
Therefore, EPDLA sees RDPs not concerned neither by the OCS initiative nor by proposed regulation COM(2023) 645.

National regulations

EPDLA is aware of national regulations, for example in France, to regulate Microplastics. In the case of the French restriction on the use of Microplastics (art. 82, AGEC law), which entered into force January 1st, 2023, it is impossible at the current stage to comment on the regulatory proposal due to the lack of definitions. French Chemical industry Associations actively advocate for a harmonization of the French regulation on Microplastic and the European regulation on SPM.

Conclusion

The EPDLA members use WPT/MFFT method to measure the initial melting point or the melting point of the film forming polymers in a polymer dispersion. If initial melting point (as measured by WPT/MFFT) is equal to or below 20°C, the film forming polymer in a dispersion does not meet the criteria of “solid” according to §2 of the restriction regulation (EC) No 2023/2055 on synthetic polymer microparticles (SPMs) Redispersible polymer powders (RDP) consist typically of two different polymers: a solid but water soluble polymer which forms the “outer shell”, and a few inner polymer droplets of a dispersion polymer. The solubility of the soluble polymer part is usually much greater than 2g/l. The “inner core” typically consists of a dispersion polymer with initial temperature equal to

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[7] Operation Clean Sweep® Progress Report 2019 - Plastics Europe DE

[8] Microplastics pollution – measures to reduce its impact on the environment (europa.eu)

or below 20°C (typically measured by WPT/MFFT method), which means, this polymer does not meet the critera as “Solid” according to regulation (EC) No 2023/2055 and has not to be considered as SPM. Therefore, both types of polymers contained in a RDP and thus the redispersible polymer powder as such do not meet the criteria for SPMs.

Disclaimer

- The present position paper has been developed by EPDLA members in good faith, to the best of its knowledge and following the latest scientific evidence.
- The position paper is offered to all EPDLA members for further use. Each producer might add additional information in the communication towards customers, depending on the specific situation.
- EPDLA commits to update this document in view of any new relevant available information.

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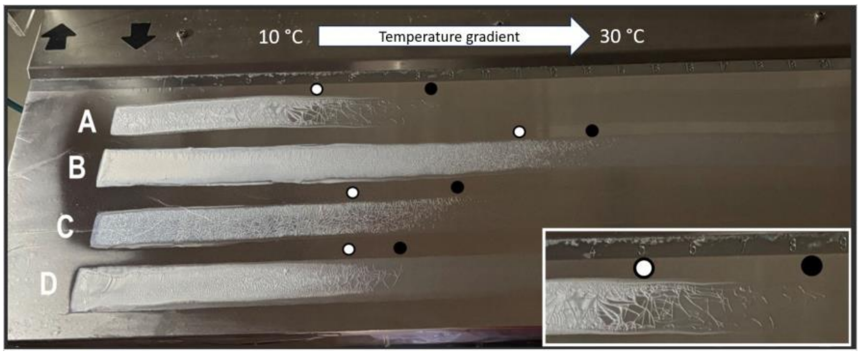
About EPDLA
EPDLA (European Polymer Dispersion and Latex Association), a Cefic Sector Group founded in 1991, is dedicated to promote the safe manufacture, transportation, distribution, handling and use of waterborne polymer dispersions, in compliance with regulatory requirements and industry guidelines. EPDLA members are committed to Responsible Care® principles and have implemented risk management according to the precautionary principles.

ANNEX I: Round robin on MFFT measurement

The MFFT was measured by 10 EPDLA member companies on four different commercially available latex samples in a series of Ring- or Round Robin tests (RR). The procedure applied was based on the DIN ISO Norm 2115. The image below shows the films of the samples A to D coated on a film bank with a temperature gradient from 10°C to 30°C. The transition from a homogeneous film without cracks indicates the MFFT and were the film start to be white indicates the White Point Temperature. Since the length of such film bank is 50 cm, the temperature gradient of 20°C over this length corresponds to 2,5 cm per 1°C, which allows precise and repeatable results.



Film bank coated with samples A to D.

○ White circles show the White Point Temperature.

● Black circles show the Minimum Film Formation Temperature.

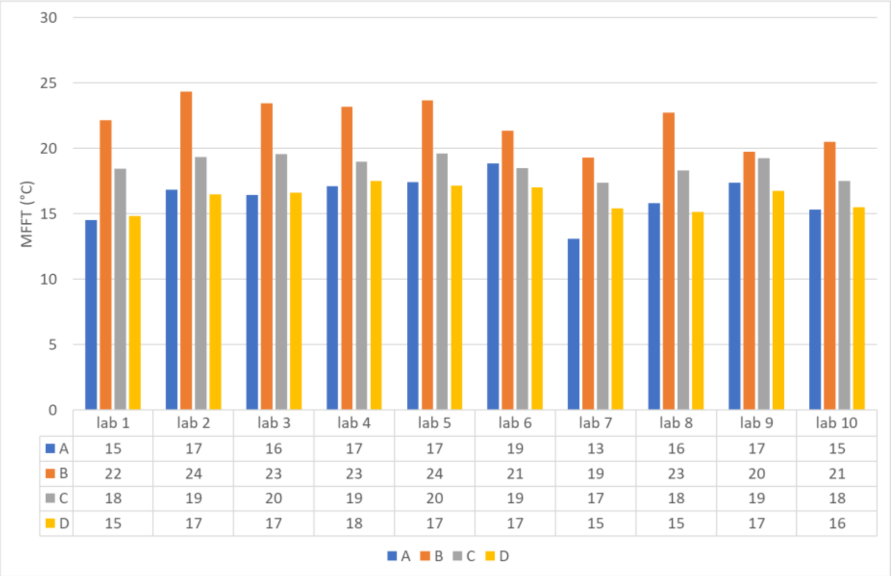
Figure 1 Film Bank coated with samples A to D

Before starting the RR the member companies agreed on some settings and procedures which are covered by DIN ISO 2115 and might have a significant impact on the accuracy of the results. The table below shows the analyzed parameter and some recommendations in the raw Harmonized procedure. However, the method turned out to be very robust and the most important considerations are the equilibration time of the film bank until a stable temperature gradient is achieved and a sufficient drying time of the latex film of three hours at least.

	Explanation	Harmonized Procedure
Instrument	Manufacturer, Model	
Method/ Standard	according DIN ISO Nom	
Instrument dimensions	length width of the tempearture gradient bank	50cm X 20cm
Film application	Blade, thickness, widthor gatter, depth, width?	100 µm
Temperature Range	i.e. from 5°C to 25°C	10°C to 30°C
Randomization of repeats	Measured films in a row or a special design	All repeats should be measured on different runs, at least three repeats
Determination MFFT	visual, with a pen, or...??	report repeat with one digit of 0.5 at least, average will be reported as integer, visually when cracks start, first crack
Determination white point	visual, with a pen, or....	report repeat with one digit of 0.5 at least, average will be reported as integer, visual, the borderline from white to transparent
Equilibrium time of the bench	Time before apply the film	after 1h or equilibrium is reached
Film forming time on the bench	Time after film application and drying before determing the MMFT	Minimum of 3h drying time
Substrate	Alumina foil, plastic foil,...	
atmosphere	Air, nitrogene, air flow, open or closed cabine	

Table 1 Recommended settings and procedures for the MFFT and White Point Temperature measurement

The diagram below (Figure 2) shows the MFFT results of all participating member laboratories. All samples were measured up to six times and 3 times at least. ISO 2115 requests a Standard Deviation (SD) below 2°C for the results. The RR shows a SD below 1,5°C for the repetition of measurements of the same latex between the companies (Figure 3).



	lab 1	lab 2	lab 3	lab 4	lab 5	lab 6	lab 7	lab 8	lab 9	lab 10
■ A	15	17	16	17	17	19	13	16	17	15
■ B	22	24	23	23	24	21	19	23	20	21
■ C	18	19	20	19	20	19	17	18	19	18
■ D	15	17	17	18	17	17	15	15	17	16

Figure 2 MFFT results

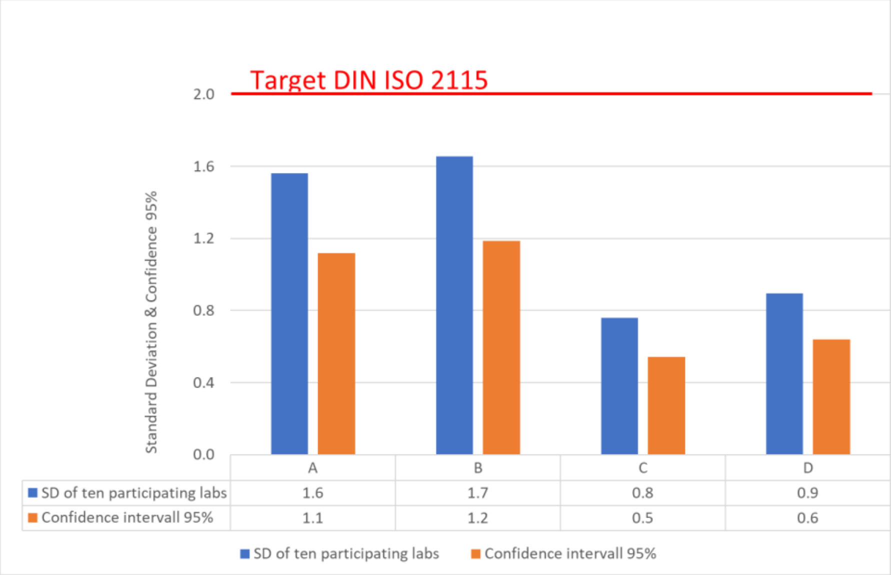


Figure 3 Standard Deviation and confidence level of the MFFT results between the company labs

The Z-Score approach was applied to quantify the difference of each company to the average of all measurements. The Z-Score expresses the deviation of results in magnitudes of the SD for a lognormal distribution. The deviation of the results from the average should be between 2 and 3 at least to fit to a lognormal distribution.

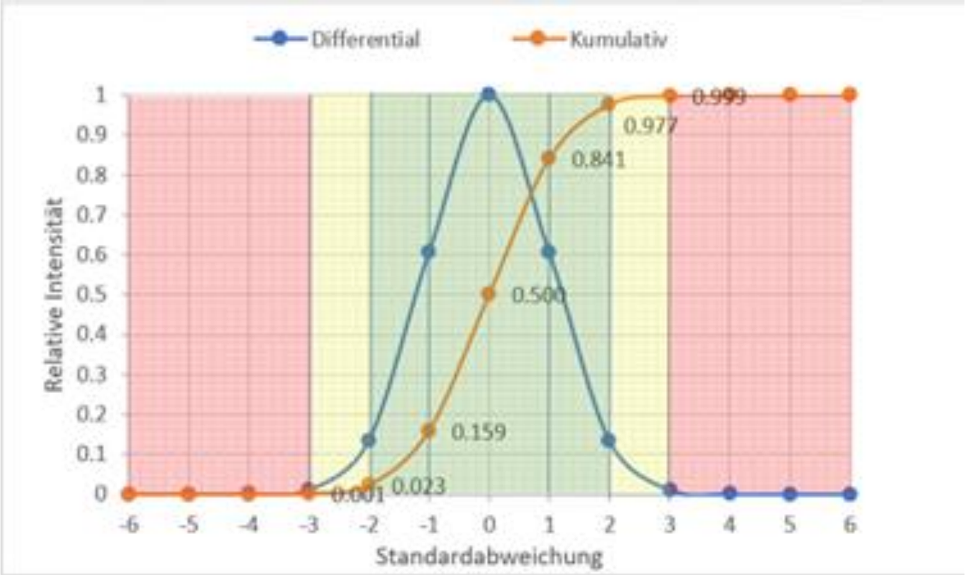


Figure 4 Lognormal Distribution with indication of the 68,2, 95,4% and 99.8% confidence interval

The Diagram below shows the Z-Score of all results for a onefold SD of 1.0°C. Most of the results deviate from the average below 2 SD (+/-2°C) and at least below 3 SD (+/-3°C).

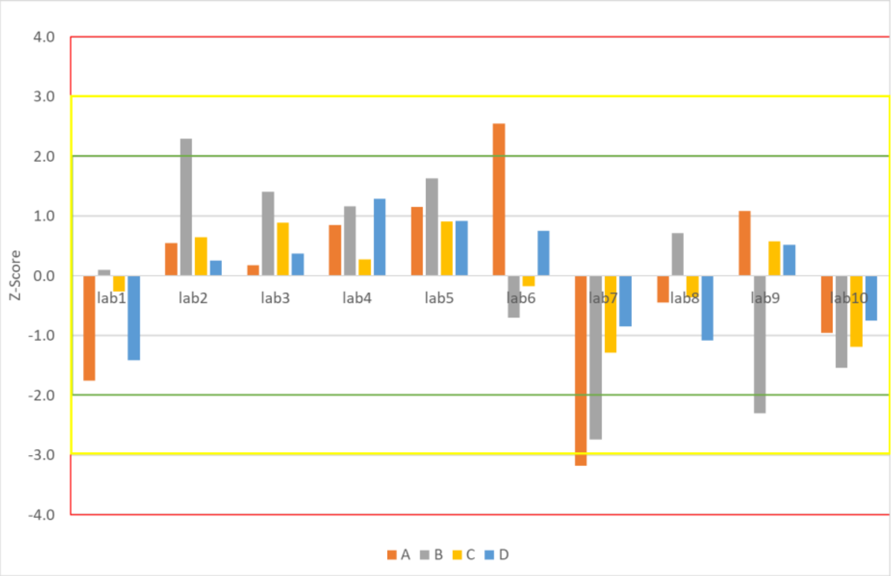


Figure 5 Z-Score of the results for a onefold SD of 0.5°C

The Diagram below shows the Z-Score for the average MFFT of the four samples measured by each company lab. The deviation between the company labs lies between 2D or +/-2°C.

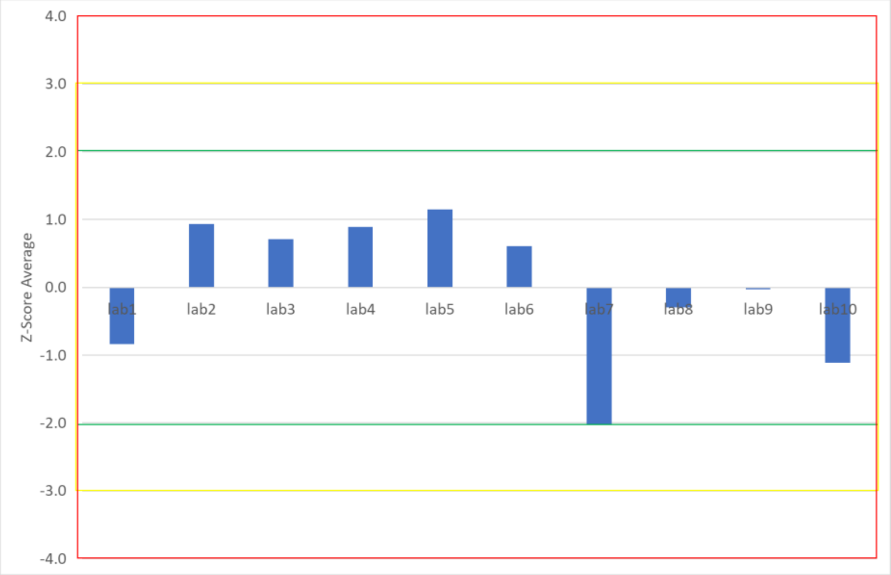


Figure 6 Z-Score for the average of four samples

Conclusion

The results of this ring test show that the inter-laboratory consistency of the MFFT measurement results is very good (<1.5°C standard deviation), when the recommendations of DIN ISO 2115 are followed. This high level of fit supports the reliability of this MFFT method for measurements of the (initial) melting point of polymer dispersions in the context of the SPM regulation.