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Correction

Correction: Wiechers et al. Development of a Process for Direct Recycling of Negative Electrode Scrap from Lithium-Ion Battery Production on a Technical Scale and Its Influence on the Material Quality. *Batteries* 2024, *10*, 218

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1. Error in Figure

In the original publication [1], there was a mistake in Figure 9 as published. Due to an incorrect tared load cell of the 90° peel test station, the measured adhesion forces were too high. The corrected Figure 9 appears below.

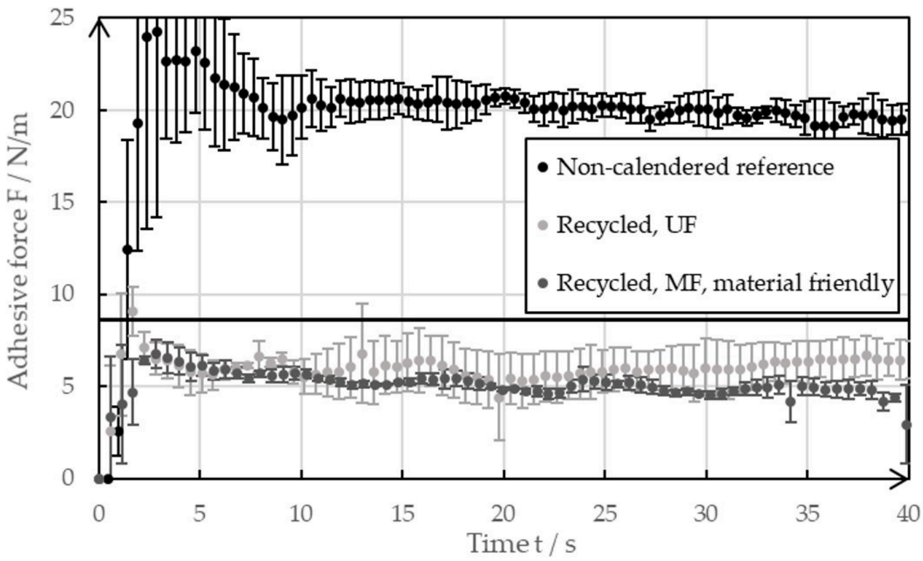

Figure 9. Adhesive force of the non-calendered negative electrodes with recycled coating, as well as the references with pristine coatings.

2. Text Correction

There was an error in the original publication [1]. Due to a typing error, the mentioned solid mass content of the used SBR and the measurement unit of the ultrasonic bath were incorrect. A correction has been made to the Materials and Methods section. The corrected sentences are now as follows:

The SBR was present in an aqueous solution with a solid mass content of 15 wt-%.

An ultrasonic bath measuring 0.28 m, 0.2 m and 0.1 m with an ultrasonic oscillator (Weber Ultrasonics AG, Karlsbad, Germany) at the bottom was manufactured for decoating the electrode foils.

There was an error in the original publication. Due to a change in the editorial office, a sentence was altered in such a way that it did not match the statement. A correction has been made to Section *3.3. Influence of the Recycling Process on the Material Characteristics*. The corrected sentence is now as follows:

Large error bars appeared at the beginning and toward the end of the measurements as the peel test did not take place in steady state.

There was an error in the original publication [1]. Due to a change in Figure 9 and the measured adhesive forces of the electrodes, the text had to be changed such that it matched the corrected values. A correction has been made to Section *3.3. Influence of the Recycling Process on the Material Characteristics*. The corrected section is now as follows:

The reference coatings dried at room temperature showed exceptionally high adhesive strength, with values reaching 20 N/m. This meant that the adhesive forces were higher than the values of the industrially produced foils of negative electrodes dried at elevated temperatures. This observation is consistent with the results shown by Baunach et al. [20], wherein the minimized binder migration that occurs due to the slow drying leads to increased adhesive forces. For the investigations that were carried out, the reference coated foils were used for the decoating experiments, as shown in Section 3.1. A typical industrial foil of the negative electrode shows lower adhesive forces, even if it is calendered. The high adhesive forces of the reference mean that the ultrasonic decoating of the real electrode residues obtained from industry tends to work even better than what was shown in this paper.

Figure 9 also indicates that the adhesive strengths of foils coated with a recycled paste were lower compared to those coated with a pristine slurry. The lower adhesive strengths suggest that the recycling process may have affected the binder's integrity. The SBR binder could have partially lost its functionality due to the high shear forces in the ultrasonic bath and the filtration system. Additionally, ultrasonic-induced degradation of CMC is likely to have negatively impacted the adhesive forces, as it promotes the effect of binder migration due to changes of the viscosity. The influence of ultrasound on the paste viscosity is further discussed and evaluated in the rheological measurement section. The effects of binder migration can be seen in the SEM images. The adhesive forces from both recycling rounds ranged between 5 N/m and 8 N/m, with electrodes coated using the recycled paste from the microfiltration (MF) cycle showing slightly lower values. The microfiltration membrane, with a pore size of 1 µm, may have allowed some SBR to pass into the filtrate, reducing its availability in the recycled material to enhance coating adhesion. In contrast, the ultrafiltration membrane pores are too small for SBR loss. Overall, a negative impact of the recycling method on electrode adhesive strength was observed. It is likely that blending recycled material with fresh material could mitigate this effect. Alternatively, adding small amounts of fresh binder might produce electrodes with improved adhesive strength. Subjectively, the adhesive forces of the recycled electrodes were still sufficiently high to handle them similarly to the reference samples.

Due to the changed Figure 9, a part of the Discussion section had to be adapted as well to fit the new values. A correction has been made to Section **4. Discussion**. The corrected sentences is now as follows:

The determination of adhesive strengths using 90° peel tests shows that electrodes made from recycled pastes exhibit lower adhesive forces compared to the reference. Shear- and ultrasound-induced changes in the binders, along with the observed binder migration, are considered the causes for the reduced adhesive strength. Both the paste of the UF and the MF pass were more fluid after the recycling than the reference paste. This can also be seen in the rheology measurements. While, in the UF recycling run, the CMC was destroyed by the long exposure time of the ultrasound and thus lost its utility as a thickening agent, the CMC in the MF run was filtered out through the large filter pore. The decomposition of CMC by ultrasound is a known phenomenon. A combination of radically induced decomposition and mechanical decomposition is assumed to be the reason for this [21,22]. The slower drying speed can lead to binder migration and sedimentation effects during drying. Such observations have already been made in a drying speed study by Baunach et al. [20]. This influences the structure and binder distribution in the dried coating. The mechanical stress also leads to a change in the particle structure of both recycling pastes, which affects the adhesive strength of the coatings. The ultrasonic decoating process mainly causes a change in the particle size reduction. This was confirmed by the measurements of the particle size distributions after the individual process steps. A significant change in the particle size distribution can be seen after the decoating process. The material-friendly recycling pass was, closer to the distribution of the reference. The ultrasound had a particularly deagglomerating effect on the carbon black agglomerates, which seemed to be partially shredded after the step of ultrasonic decoating. The subsequent filtration step did not lead to any significant change in the particle size distribution measured. The aforementioned effects of drying, binder migration and particle size reduction can be seen in the SEM analysis of the coatings. The coating of the UF passage showed a complete top layer of finely dispersed carbon black and binder. Only a few graphite particles could be seen through the top layer. The originally spherical graphite also showed sharp fractured edges. However, the majority of the graphite could not be assessed as it was not visible under the surface layer. In contrast, the SEM examinations of the coating from the material-friendly passage showed significantly fewer changes. The condition was, therefore, also visually closer to that of the reference.

The authors state that the scientific conclusions are unaffected. This correction was approved by the Academic Editor. The original publication has also been updated.

Reference

1. Wiechers, P.; Hermann, A.; Koob, S.; Glaum, F.; Gleiß, M. Development of a Process for Direct Recycling of Negative Electrode Scrap from Lithium-Ion Battery Production on a Technical Scale and Its Influence on the Material Quality. *Batteries* **2024**, *10*, 218. [CrossRef]