CAS *touch!* Charge Analyzing System & **FPA *touch!*** Fiber Potential Analyzer

Optimization of the wet end of the paper and board production by professional charge and zeta potential measurement.

Agenda

1. General background
2. What is the main target of the CAS *touch!* Charge Analyzing System
3. What is the main target of the FPA *touch!* Fiber Potential Analyzer
4. Schematic illustration of the wet end process in five different degrees of optimization of consumption of chemicals
5. CAS *touch!* test procedure
6. Why are tests with the FPA *touch!* are so important
7. What are reasons for inaccurate results
8. Conclusion

General background

In the paper making process there are fibers, fillers, fines and trash particles (mainly when using recycling paper), suspended in the pulp. Most colloidal or filler particles and fiber surfaces are covered with a negative or positive charge cloud on the surface. Negative and positive charged particles attract each other. Particles with the same charge repel each other. The charge of pulp fibers is anionic (-), also the charge of trash particles is usually anionic (-). Functional chemicals, which are used to determine the quality of the finished product, and process chemicals are mainly cationic (+) charged. Cationic chemicals attract to anionic charged fibers. The knowledge of the charge of the chemicals, the anionic trash and the fibers enables a correct and effective dosage of charged chemical additives. By measurement of these charges, the CAS Charge Analyzing System and the FPA Fiber Zeta Potential Analyzer enable the optimization of the dosage of chemicals in the wet end of the paper manufacturing process. With help of these devices, the optimal adsorption of cationic starch, wet strength resin, and many other chemical aids on the fibers can be easily determined with original samples on-site.

What is the main target of the CAS touch! Charge Analyzing System

The main target of CAS measurements is to get information about the amount of anionic trash in the pulp suspension, to determine the optimal dosing of trash catcher/ fixing agent for its neutralization.

Problem description

If some cationic chemicals are added in the wet end process, its reaction is dependent on the status of the trash particles and the previous process steps:

1. The cationic chemicals can stick on the anionic trash particles and/or it can stick on the anionic fibers. If it would stick on the anionic trash, it would neutralize it.
2. The neutralized trash particles would pass through the wire together with the white water and are thus rejected in the waste water.
3. This would additionally result in a higher consumption of flocculation agents for the waste water treatment.
4. In order to get the necessary amount of chemicals on the fibers to guarantee a desired quality of the finished products, this would result in additional dosing demand of the paper chemicals

Solution

1. Step one

   Determination of the cationic demand by the help of the CAS *touch!*

   Therefore, in the pulp preparation the first step has to be to get information about the amount and charge of the anionic trash. The CAS is used to determine the cationic demand (how much Polydadmac is necessary to neutralize the charge in the CAS measuring cell).

2. Step two

   Neutralizing the anionic trash for optimal process control and cost saving

   For that purpose, anionic trash catcher (ATC) is quite common. ATC has a high affinity to anionic trash particles. It can stick on it and neutralize it (see point 4, image III). By knowing the cationic demand, the user in the paper mill can calculate the dosing of the trash catcher to neutralize the anionic trash for an optimal process control and cost saving.
   The costs for trash neutralization with ATC are much lower than for neutralization with paper chemicals like starch, because the charge density of ATC is very high, compared to process chemicals like starch: the price of ATC is in the same range like the price of starch, but because of the much lower consumption of ATC a huge amount of material can be saved.

3. Step three

   Measurement of the ATC efficiency with CAS

   After the neutralization of the anionic trash it is recommended to measure the cationic demand again to check the efficiency of the ATC. The perfect level would be a cationic demand of 0.00ml or at least close to 0.00ml, measured with the CAS. But in a real process it is almost impossible to reach the perfect level. A simple rule is: the neutralization was successful if after the dosage of ATC, the cationic demand is lower than 10 % of the previous cationic demand. Also, for the optimization and control of the subsequent dosing points of chemicals the CAS can be used: under the presumption of optimized trash neutralization, the charge demand before and after dosing of chemicals should be similar; because when the chemicals have an optimal reaction in an optimal charge environment, all of them stick on the fibers. The charge demand does almost no change in this case. Another rule of great generality is: the

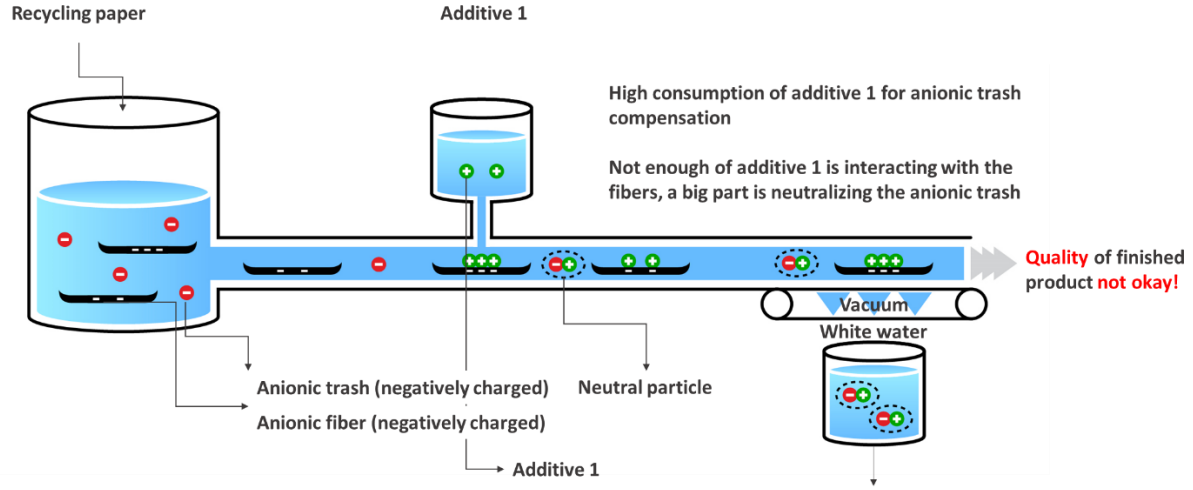
cationic demand should be decreasing from the beginning of the wet end area up to the last measuring point.

What is the main target of the FPA touch! Fiber Potential Analyzer

The main target of FPA measurements is to get information about the Zeta Potential of fibers for the determination of the optimal reaction of chemicals with the fibers. To guarantee optimal quality properties of the finished products (sizing degree, low dusting, strength, stiffness) the dosed chemicals have to stick on the fibers. This reaction is provided mainly by the opposite charge of the chemicals and the fibers. All chemicals, which do not stick to the fibers, can pass through the wire and be released together with the white water. The fiber charge is called “Zeta Potential”. The fibers need a specific value of this Zeta Potential to have enough “space” for the adsorption of the necessary amount of chemicals. If the trash would be neutralized, but the zeta potential of the fibers would not be optimal, the process and finally the finished products cannot be optimal, because the chemicals will not react with the fibers (see point 4, image IV). To measure this behavior the FPA is absolutely indispensable.

Schematic illustration of the wet end process in five different degrees of optimization of consumption of chemicals

Non-optimal process control I
No trash compensation by fixing agent

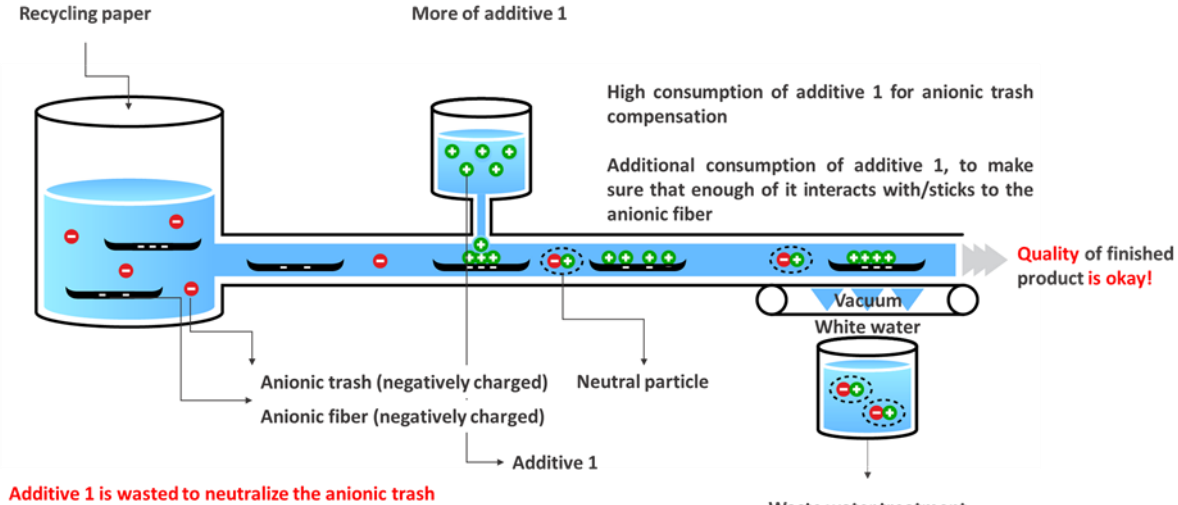


Additive 1 is wasted to neutralize the anionic trash

Because of relatively low charge density high dosing necessary for trash compensation

Not enough of additive 1 interacts with/sticks to the fiber

Non-optimal process control II
No trash compensation by fixing agent

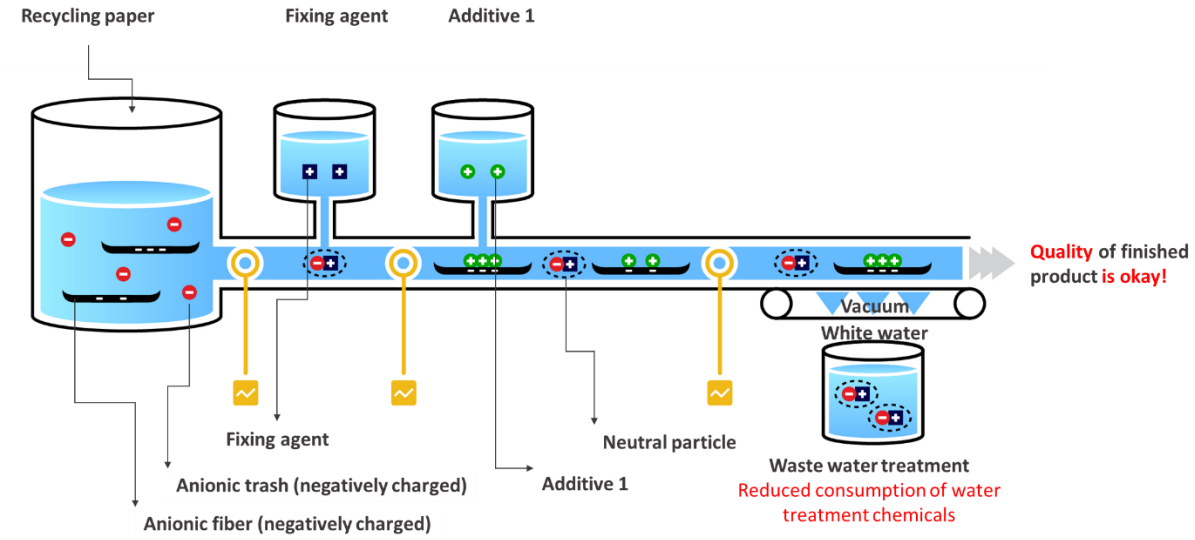


Additive 1 is wasted to neutralize the anionic trash

To guarantee an appropriate quality of the finished product, more of additive 1 needs to be added to the process.

Optimal process control III

Addition of fixing agent and measurement of the cationic demand with the CAS before and after each dosing point

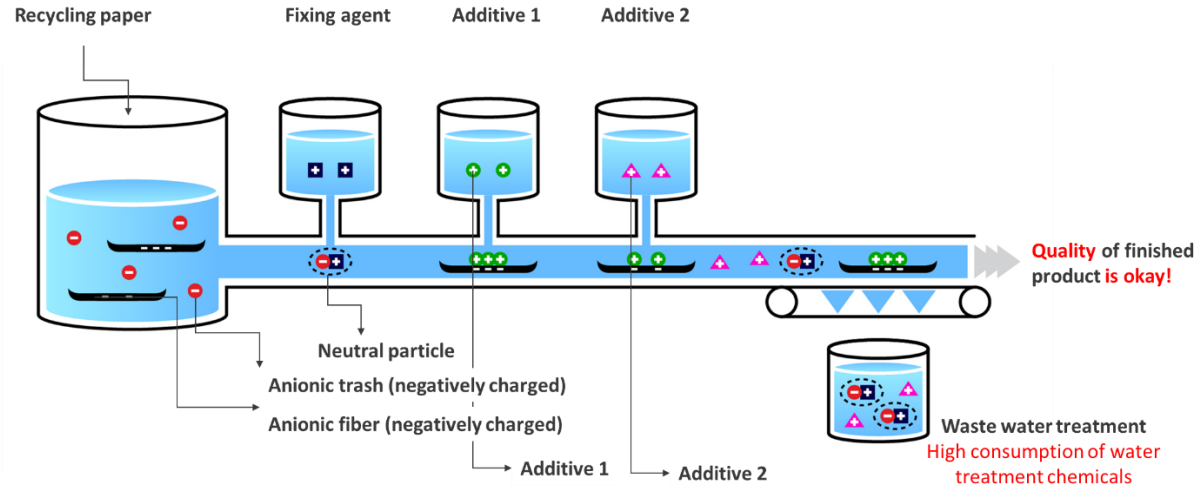


Sampling points for CAS measurements

Fixing agent neutralized the anionic trash before the dosing of additive 1

The dosing of fixing agent before the dosing of further additives helps to avoid complaints and overdosing of chemicals.

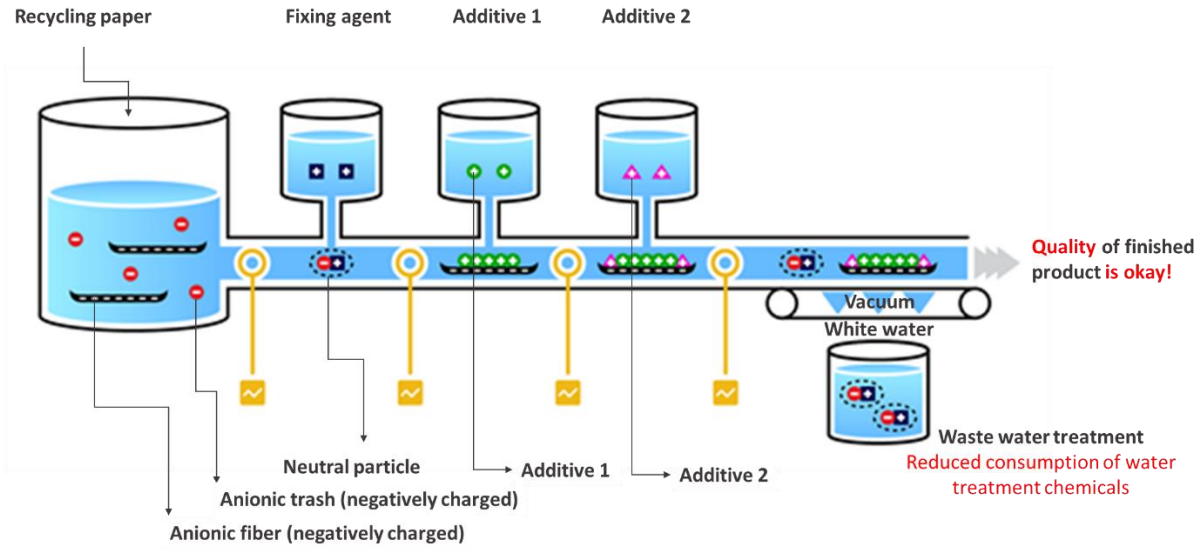
Non-optimal process control IV
Additional dosing of a further additive



Problem:

Additive 2 does not stick to the fiber, because there is not enough space left, after additive 1 has been added. Additive 2 ends up in the white water.

Optimal process control V
Additional dosing of a further additive, measurement with FPA/FPO



Now:

Additive 2 does stick to the fiber, because the zeta potential is optimized by the help of the FPA/FPO

CAS touch! test procedure

1. Take pulp suspension samples from different dosing points before and after dosage of chemicals (see point 4) and take a filtrate. Common are sample points like mixing chest, machine chest, head box and white water. But like already explained: the first and most important point is the determination of the anionic trash and the optimization of the amount of fixing agent. For that, it is necessary to take samples before and also after the dosage of fixing agent!

2. Two possibilities to get the filtrate:

   (a) use the screen, which is part of the CAS delivery content

   (b) if also an FPA Fiber Potential Analyzer is available, it is recommended to use the FPA get the filtrate. Use the FPA function “filtrate removal” to have every time stable conditions for the filtrate. Because of the soaking of the electrolyte through the fiber plug, the filtrate properties are then closer to the reality.

   The filtrate should be mixed or stirred before taking out the sample for the CAS measurement.

Why are tests with the FPA touch! so important

The dosed chemicals should lead to an interaction with the fibers. In particular, they should stick on the fibers because of electro-chemical forces. The FPA is necessary to measure the interaction between fibers and chemicals. There is no other way to get information about this interaction. It is recommended to take samples before and after dosing of chemicals, to get information about the desired reaction of chemicals with the fibers. Common chemicals are cationic starch, wet strength agent, dry strength agent, optical brightener. These chemicals are necessary to determine the quality of the finished products. Only the use of the Particle Charge Analyzing System does not provide information about the interaction between fibers and chemicals. Assuming, everything is on the right track if the cationic demand is not changed after the dosage of chemicals, is a big mistake! Like in Point 3 already explained: for an optimal process control it is absolutely necessary to determine the complete charge environment in the wet end system, it means both with the CAS and FPA. Otherwise, it is impossible to optimize the consumption of chemicals. In this case the guarantee of desired properties of the finished products is only possible by overdosing.

What are reasons for inaccurate results

Compare the measured results and understand the meaning of the values. By understanding the reasons for the issues, solutions can be implemented into the process.

Device	Issue	Reason
CAS	Very often in the wet end process in paper/board mills it happens that the neutralization of anionic trash was not successful.	This is due to too less fixing agent or (in worst case) no fixing agent was added.
CAS	After the dosage of e.g. cationic starch or wet strength agent, the cationic demand is much lower than before.	The reason is that the process chemicals neutralized the anionic trash and therefore it cannot interact with the fibers anymore. It results in a much higher dosing demand on chemicals, which implies overdosing!
CAS/FPA	After the dosage of cationic starch or wet strength agent there are no changes compared to the previous values.	This is due to non-optimal process control: No interaction with the fibers happened, and probably there are also too many anionic trash particles in the pulp.

Conclusion

CAS touch!

Is necessary to determine the optimal dosing of fixing agents and to determine the efficiency of chemicals in the wet end process. The device can also be used to determine the charge density of polymers in the incoming control and to optimize the dosage of chemicals in the wastewater treatment.

FPA touch!

Is necessary to determine the ability of fibers to react with the chemicals.

Contact

AFG Analytic GmbH, Gorkistr. 31, 04347 Leipzig, Germany

email: info@afg-analytic.de

website: www.afg-analytic.com