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Electrolysis preparation of vegetable washing water

For treatment of dirty water after washing of potatoes and vegetables the electrolytic system has proved itself better than the standard sedimentation systems because the water to be cleaned is clarified in the shortest time after application of the required electrical energy.

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Waste water clarification, electrolysis, processing parameter, washing of vegetables

Dirty water from potato and root vegetable washing normally contains earth and plant remains. A problem with this is that fine organic remains, but especially inorganic dirt particles such as clay and loam, cannot be removed from the water quickly with standard mechanical processes [1].

With electrolytic treatment, turbid dirty water can be processed into clear usable water within a short time. Up until now, this system has been conceived for use in the industrial galvanisation technology, paint production and in the metal industry. A programme supported by the BMBF had the target of transferring the electrolytic treatment for use in the treatment of vegetable washing water.

Principle of the electrolysis system

In the electrolytic cleaning of water a direct current is passed between two electrodes placed in dirty water, or in other liquids that have to be cleaned. This causes several electrolytic processes to take place [2, 3, 4] (*fig. 1*).Firstly, through the electricity field in the water, the charge condition of the dirt particles and colloidal suspension is changed. The colloidal particles, which are mostly negatively charged, are neutralised and cluster with one another through adhesion. According to Faraday's Law, metal ions, in relationship to the strength of electrical current and the process time, are set free from the anode which, with water hydroxide ions, translates into large-particle discharged metal hydroxide complexes. Moreover, hydrogen and oxygen gases are formed on the electrodes. Through adhesion the discharged dirt particles cluster onto the metal hydroxide flocculant. Because of their enlarged diameter the agglomerate of dirt particles and metal hydroxides sediments out in a very short time (Stokes' Law) [5].

Materials and method

Model washing water
The model washing water was produced from 1.7 g Sigrano ground quartz type SP13, 1.0 dried carrot powder in 1 l of tap water.

Electrolysis batch reactor
The batch small scale reactor consisted of a 100 ml capacity glass container. Inserted within the reactor space was a pair of electrodes comprising different compounds. The gap between the bare 30•30 mm electrodes was 3 mm.

The model washing water was electrolytically treated within the reactor with a defined electrolysis voltage of between 3.5 and 25 V.

The clarification process was taken as completed when around 50 formazine units (TE/F) could be measured with the turbidity measuring equipment. After a settling time of around 20 minutes for the flocculated particles the OCR of the clarified liquid was determined.

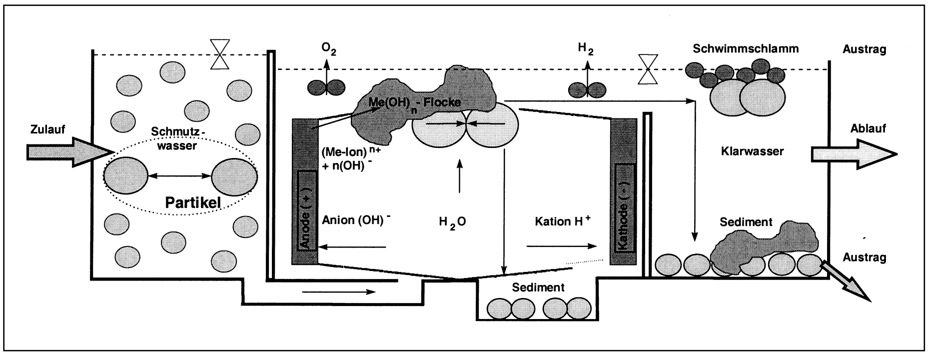

Fig.1: Scheme of electrolytic clarification

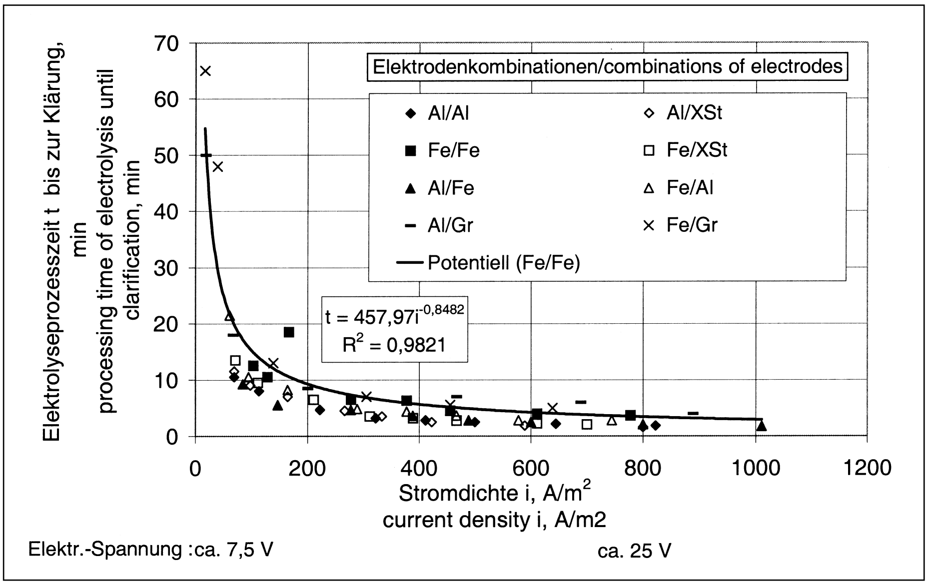

Fig. 2: Processing time of clarification of model washing water depending on current density and different combinations of electrodes

Trial results

The association between current density (= intensity of current based on electrode surface area) and process time is presented in *figure 2*. In this it was possible to determine a potential association for all tested electrode combinations: with increasing electrolysis voltage the time taken by the electrolysis process for the clarification of the model washing water was reduced. The electrolysis period with aluminium anodes was shorter than that with iron anodes.

In order to exclude the effect of increased oxygen and hydrogen gas production thorough increased electrolytic current, trials for electrolytic clarification of model washing water were carried out with low electrolysis currents and doubled processed time (*table 1*).

Through doubling the electrolysis process time with 5 V as well as with 15 V the COR value in model washing water could be reduced by a further 9% and 7% respectively. The substantially higher COR reduction (5.5%) achieved with low electrolysis current and increased electrolysis times was achieved with around half the electrical power compared with where higher current and reduced process times were applied.

Conclusion

The electrolytic treatment can be applied for the complete withdrawal of earth and other colloidal loose particles mainly responsible for the turbidity of vegetable washing water. The process also takes place within a very short period of time. Such a process would allow the surface area of settling basins to be reduced. Very little separation took place of the organic substances already in solution (COR value). Electrolytic clarification of washing water influenced by a suitable choice of parameters. There is a direct association between electrolysis current and electrolysis process time. The product from both parameters sets free a defined amount of electrode material for the precipitation of a certain amount of the dirt load whereby as a whole, this process is a very complex one, made so by parallel-acting chemical and thermal procedures. Moreover, the intensity of the electrolysis current continues to be dependent on the applied electrolysis current, the design and measurements of the electrolysis unit, and the conductivity of the liquid to be treated.

High electrolysis currents which result in very short process times for clarification, cause a high gas production and this has the result of the applied amount of electricity not being able to be fully transformed into chemical precipitation material. This causes the cost of the electrical input to be overproportionally increased [6].

Table 1: Results of electrolytic treatment of model washing water at 5 V and 15 V and single and double processing time with aluminium/graphite-electrodes

Voltage (V)	Process time (min)	Electricity power requirement for clarification (kWh/m^3)	COR after electrical treatment (mg O_2/l)	COR-reduction (%)
5	12	0,80	673	42,1
5	24	1,60	569	51,0
15	4	2,90	633	45,5
15	8	5,80	557	52,0

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