TREATMENT OF HYDROMET PROCESSING CRUDE USING DECANTER CENTRIFUGE

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ABSTRACT

In the Hydrometallurgical processes, the presence of the so-called "crud" is a constant challenge in solvent extraction. Crud is a stable emulsion which forms along the interface between the aqueous and organic phase. The spread is influenced by the following parameters: first, wind blows the dust and impurities into the open sedimentation tanks. Second, the undissolved solids such as sand transported in the PLS causing problems in conjunction with incorrect agitator design. The crud fraction can decisively impact the efficiency of the hydrometallurgical extraction because the phase interface can constitute a large fraction and the sedimentation tanks cannot react flexibly to it. In the downstream process of the series-connected sedimentation tanks, they are thus all contaminated with crud. At the same time, the necessary mass transport is significantly impeded at the phase boundary between organic phase and aqueous phase due to the crud formation. The transfer of the organic phase into the electrolysis cell can result in a "burnout" of the cathode. The carry-over of this electrolyte into the extraction can cause problems with the pH regulation. The carry-over of the organic components into the raffinate also leads to contamination of the leaching circuit. The continuous treatment of the crud with a 3-phase decanter centrifuge is extremely effective in combating this problem. This technology splits all three phases from each other and they are consequently continuously separated. All subsequent process steps exhibit a stable, uniform effectiveness. The main advantage for the customer is that fluctuations in the process are eliminated and the organic phase can be recirculated back to the extraction. The recycling of the solvent alone justifies the investment in less than 6 months as examples from South Africa and Chile show. To operate solvent recovery in daily operation fully automated online at the optimum limit, the decanter centrifuge is equipped with a concentration-dependent pond adjustment called DControl®. By this means, we can guarantee our customers the maximum possible solvent recovery and minimise the solvent costs in this process step. This system is presented in detail in this paper.

MET SOC
CIM ICM

Towards Clean Metallurgical Processing for Profit, Social and Environmental Stewardship
Proceedings of the 51st Annual Conference of Metallurgists of CIM (COM 2012)
Niagara, ON, Canada
Edited by
R.H. Schonewille, D. Rioux, S. Kashani-Nejad, M. Kreuh, M.E.S. Muinonen

INTRODUCTION

The number of applications for continuous centrifugation in the hydrometallurgical process is rising continuously. This development is characterized by a number of customer demands in which decanters are clearly superior to other competing technologies.

The customer demands such as productivity, process specifications, reliability and profitability can be achieved and even surpassed. The demands of different production facilities involved in the hydrometallurgical processing always vary because the respective composition of the ore typically requires unique process configuration. Consequently, application-specific demands are realized in close cooperation with the customer. Preventive service concepts are a basic pre-condition for constant plant availability which ensures the customer's leading position in the market segment.

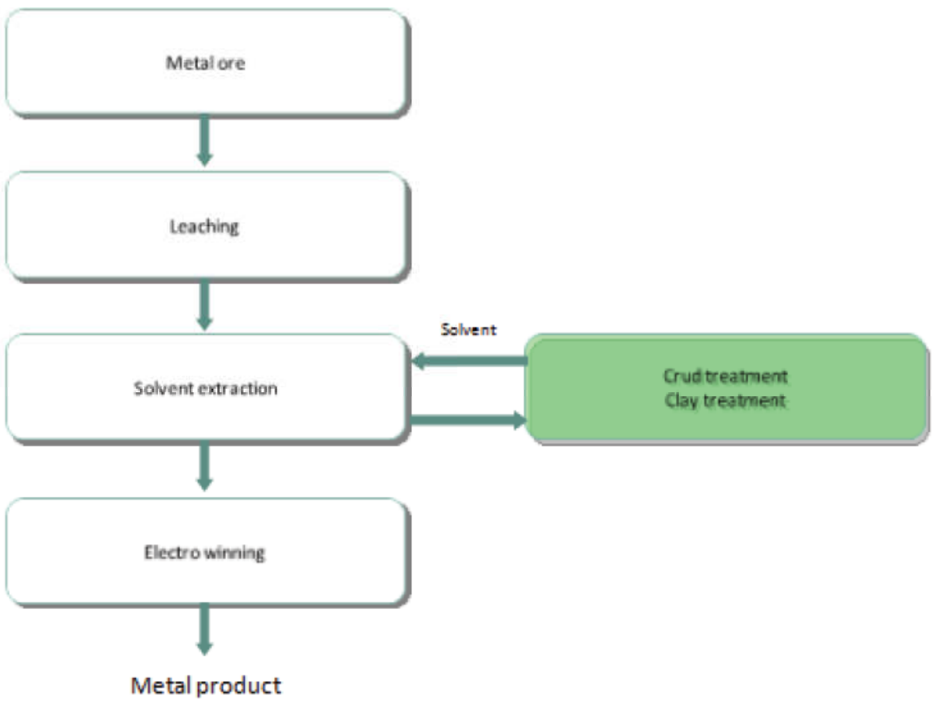

Figure 1 – Process schematic of crud formation

One example of this is the recovery of copper in an SX installation. Discharged insoluble solids lead to crud formation.

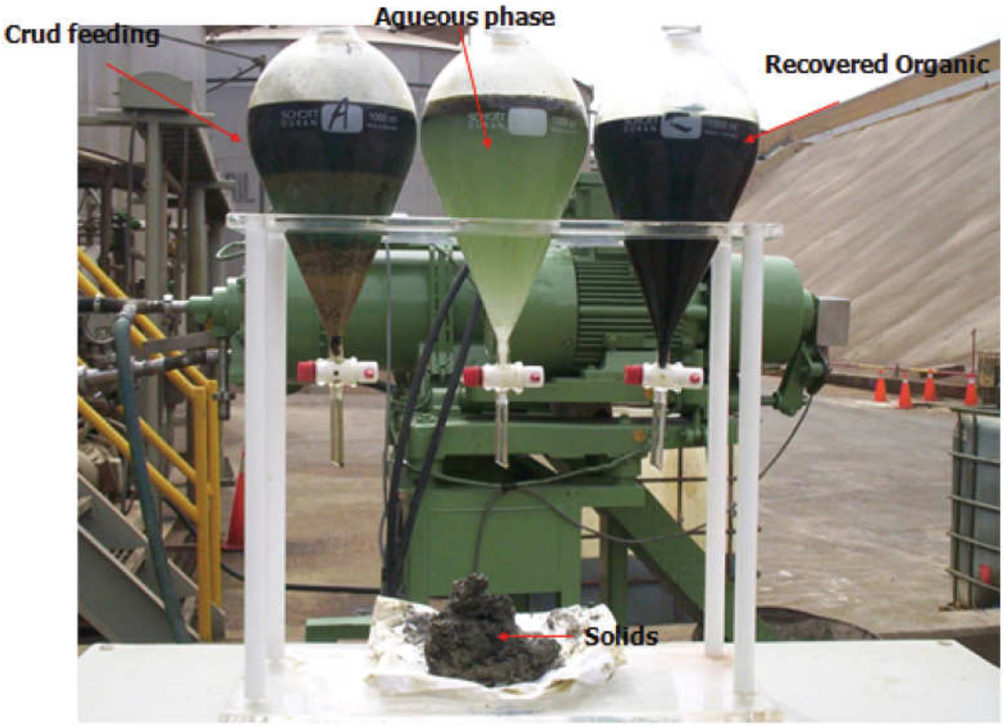

Figure 2 – Phase distribution in copper recovery

This can lead to a situation where aqueous components are transported into the recovery process during recycling or to the valuable organic phase. This can result in increased chloride contents when the ores contain Cl^- or if seawater is used for the process. This, in turn, can lead to pitting on the storage tank or on the stainless steel agitator.

For this reason, the crud phase cannot be recycled back into the process. Disposal is, however, likewise uneconomic because on one hand the organic phase is a valuable operating fluid and, on the other hand, dissolved metals are to be recovered in the aqueous phase. The crud phase must therefore be split up into the three phases; solids, aqueous and organic phase.

Previously, different chemical processes were used for this with which the emulsion was split. However, it has been demonstrated that continuous centrifugation is the most effective and economical technique.

The crud from a SX installation is discharged into the crud tank. From there it is conveyed into the centrifuge which separates the aqueous components and the solids from the organic phase. The liquid and solids are recycled into the raffinate basin and the organic material is recycled back into the SX installation. The main purpose of this operating mode is to relieve the installation from the emulsion and to recover the expensive organic solution.

To a certain extent, the formation of crud depends on how far the particles exhibit hydrophobic properties.

During centrifugation, centrifugal force is produced through the rotation of the bowl which is normally a multiple of the force of gravity. This is expressed in terms of the so-called g-force which represents the ratio between centrifugal acceleration and acceleration due to gravity. A relative velocity is applied to the heavy components (particles, drops) of the feed suspension as a function of the g-force.

The decanter is generally used to separate solids from a liquid (two phases). Three-phase systems can also be processed with a special version. In addition to separating the solids, the liquid is separated into a light and a heavy phase.

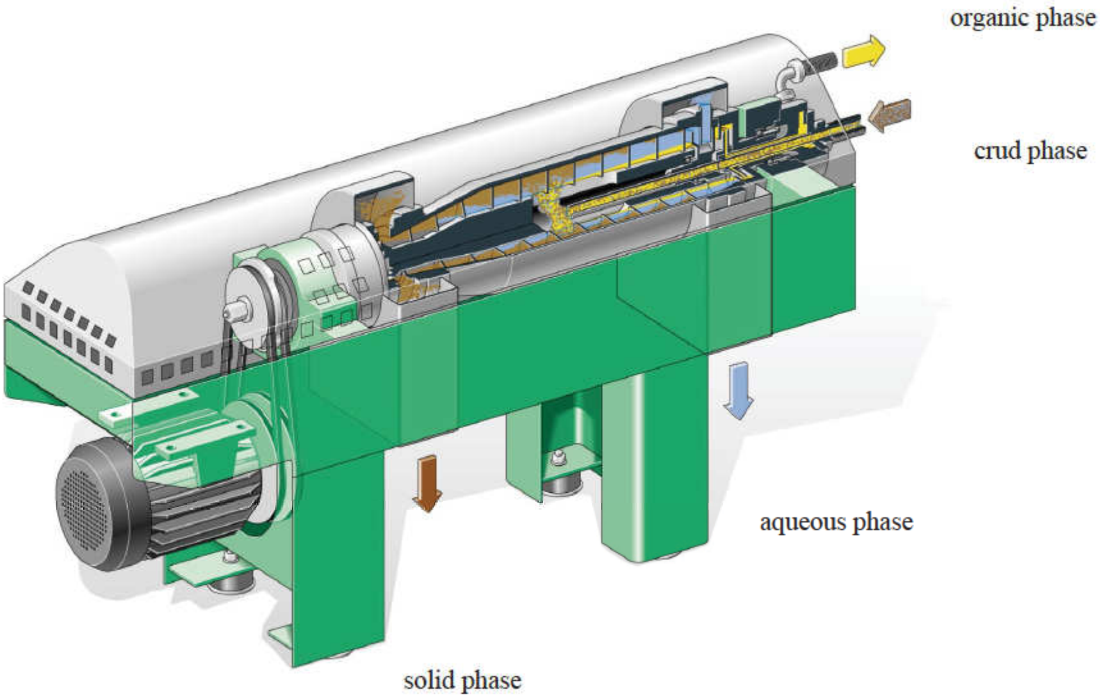

Figure 3 – Design of a three-phase decanter

Figure 3 is a schematic representation of the design of a three-phase decanter. The separation and dewatering of the suspended particles, which generally exhibit the highest density of the individual components, is analogue to other decanter centrifuges by sedimentation on the inner bowl wall. The two liquid phases are separated simultaneously under the action of centrifugal force. The fluids build up layers in the bowl in accordance with their density. The phases are separated independently from one another at the cylindrical end of the bowl. The respective phases are either discharged under gravity over a weir or under pressure by means of a centripetal pump. In the case of the variant illustrated in Figure 1, the heavy phase discharges under gravity, the light phase by means of a centripetal pump (Stahl, 2004).

In the system presented here, the overflow diameter of the aqueous phase is firmly defined and cannot be altered online. The diameter of the organic phase corresponds to the pond depth and is narrower than the overflow diameter of the aqueous phase due to the difference in density between the two liquids. Between the two layers is a boundary layer at the liquid-side end of the bowl which is called the separating zone. The position of the separating zone within the sedimentation pond depends on the liquids to be processed and the overflow diameters. This is illustrated in Figure 4 where the position of the separating zone is plotted over the pond depth. The parameter is the overflow diameter of the heavy phase.

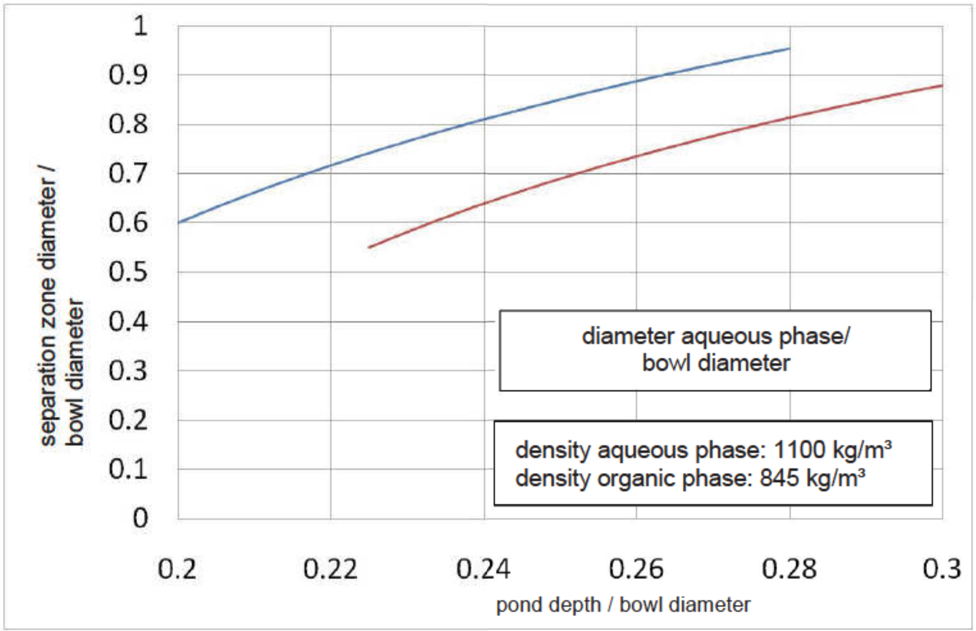

Figure 4 – Position of the separating zone as a function of the pond depth

To realize a separating process that is as effective as possible, the position of the separating zone must be adapted to the given phase distribution in the feed suspension which may be subject to temporal variations depending on the raw materials and the process management. A system is therefore desirable to allow online displacement of the separating zone as a function of a suitable control parameter.

DENSITY DEPENDENCE OF THE ORGANIC PHASE

In the process under consideration here, the organic phase is primarily a valuable substance which should be recycled to the process without impurities if possible. A potential contamination originates largely from the aqueous phase. There is a density difference between these two liquids. A contaminated light phase accordingly has a higher density compared to the pure organic liquid. This is graphically represented in Figure 4.

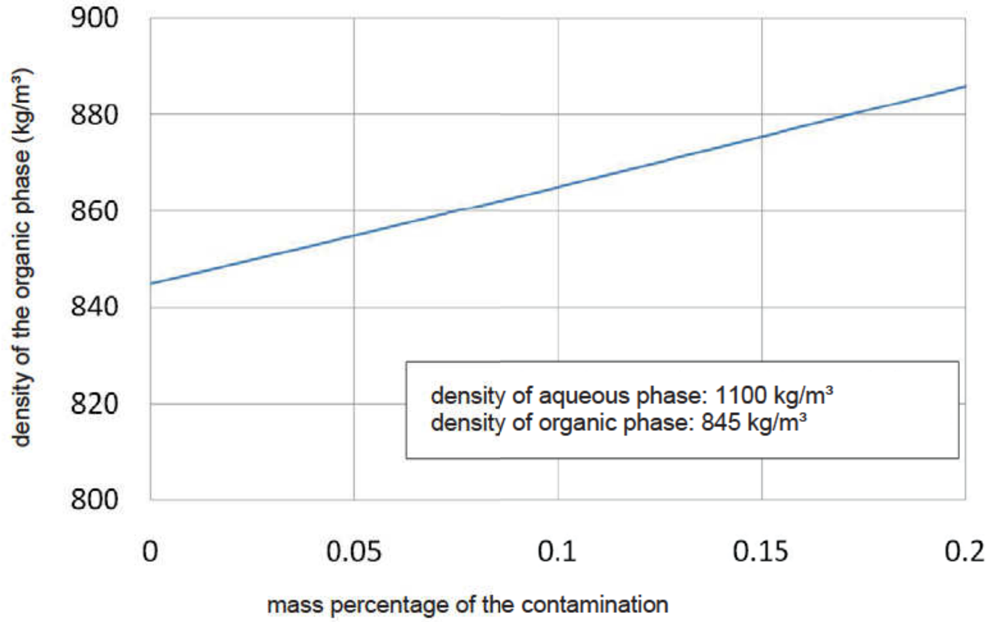

Figure 5 – Density of the contaminated organic phase

The density of the valuable substance therefore serves as an indicator for the contamination of the organic phase.

SYSTEM DESCRIPTION

The system illustrated here is shown in Figure 6. The decanter is configured as a three-phase decanter as described above. The aqueous phase is discharged via the bowl outer diameter into a catcher and flows off via the decanter frame. The organic phase is discharged under pressure by means of a centripetal pump.

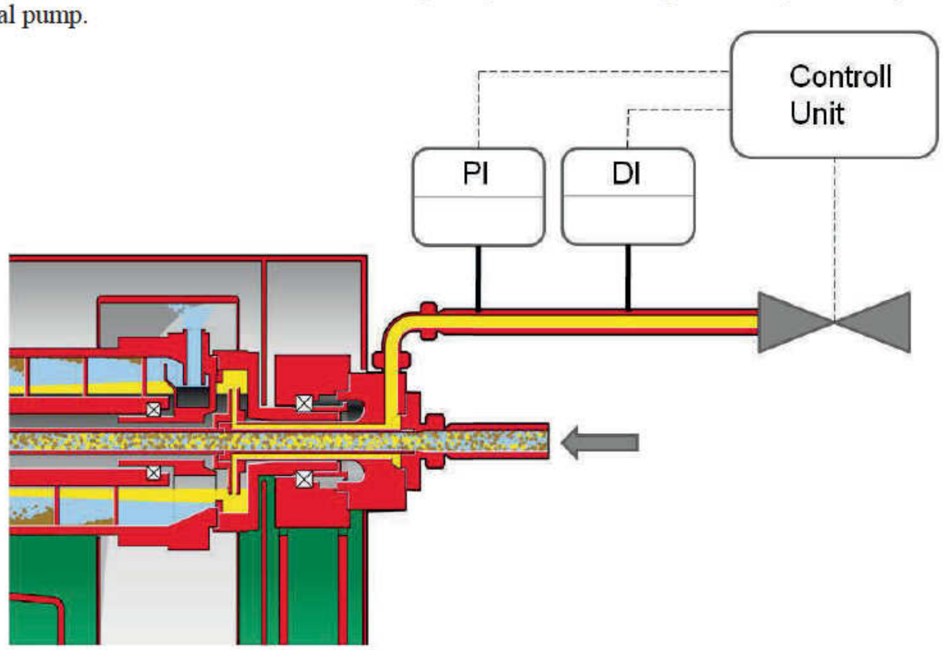

Figure 6 – Schematic illustration of the concentration-dependent pond adjustment

In addition to the standard pressure gauge, a density measuring device is also integrated in this discharge. In the control unit the measured density signal is evaluated in accordance with Figure 5 to determine contamination through the aqueous phase and is compared with a limit value.

Figure 7 shows a possible phase distribution in the decanter bowl. The organic phase (yellow) accounts for a very small proportion so that there is a short retention time in the centrifugal field. As a result, heightened contamination of the organic phase can occur which is detected with the density sensor. If the admissible limit value is exceeded, the valve is actuated accordingly resulting in a higher discharge pressure. As the discharge pressure rises, the immersion depth of the centripetal pump in the pond increases, which means that the pond depth likewise increases. In accordance with the relation described above, the separating zone is displaced outwards. This state is illustrated in Figure 8.

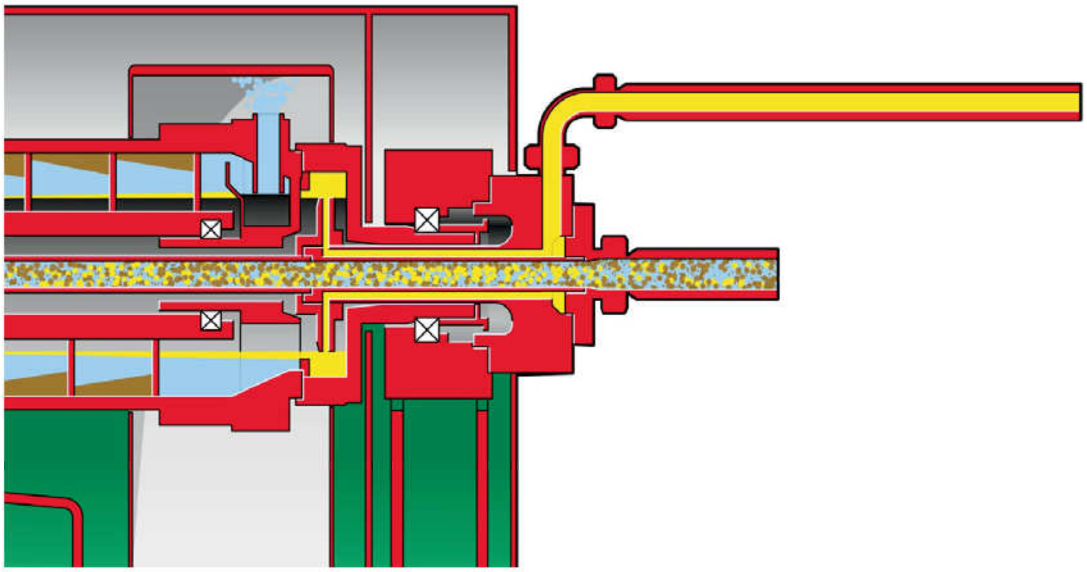

Figure 7 – Position of the separating zone without increased discharge pressure

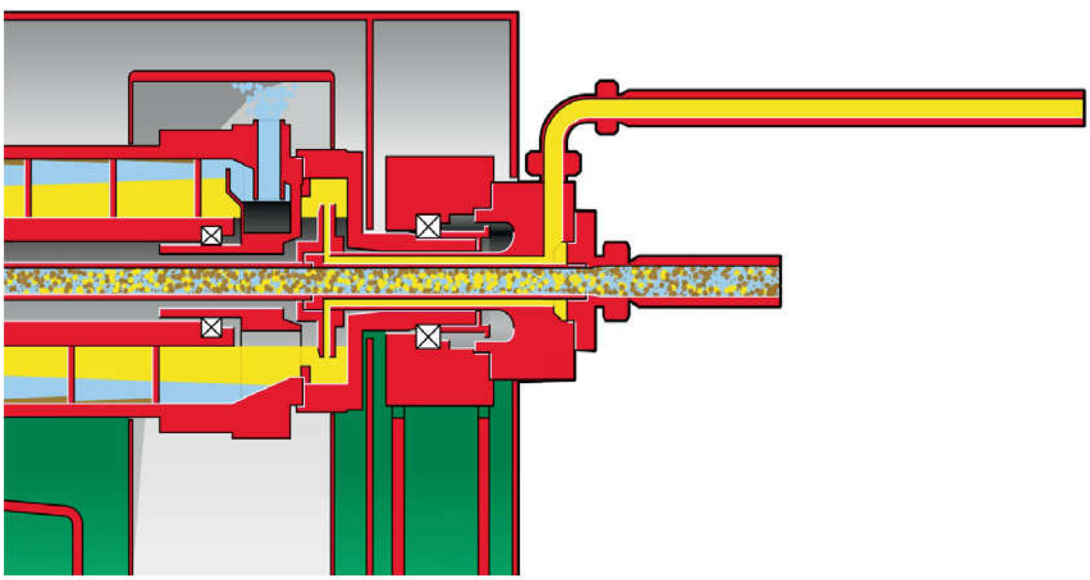

Figure 8 – Position of the separating zone with increased discharge pressure

As a result of the displacement of the separating zone outwards, the volume of the organic phase in the bowl increases and the retention time in the centrifugal field is longer. The result is an improvement in the degree of purity of the organic phase due to the externally induced increase of the discharge pressure.

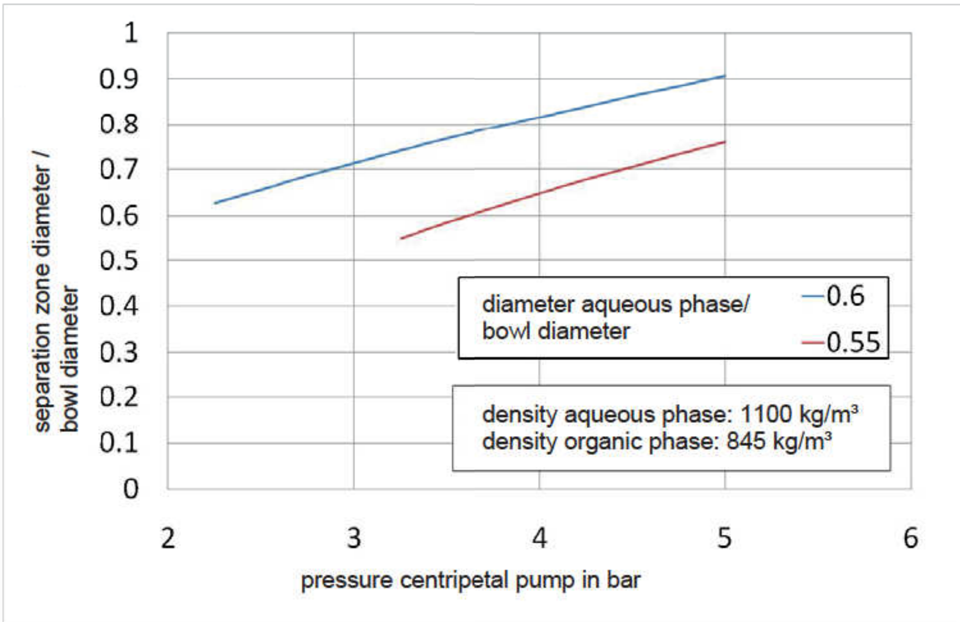

Figure 9 – Separating zone diameter as a function of the discharge pressure

If the discharge pressure is increased too sharply, a particularly pure organic phase is recovered but there is an increased loss of the organic phase into the aqueous phase and possibly also the solids. In this case, the operator can optimally adjust the parameters throughput capacity, yield of organic phase and degree of purity of the organic phase to the specific operating situation.

SUMMARY

By means of the patented DControl® system, it is possible to achieve the maximum possible solvent recovery and reduce the solvent costs to a minimum. The economy of the entire process is improved since the transfer of the organic phase into the electrolysis cell and also the contamination of the leaching circuit is minimised. The separated aqueous phase and the solids can be recycled into the raffinate basin by which means the installation can be optimally relieved from the emulsion and the valuable recovered organic solution from the SX installation can be recycled. The process demands of the customer with regard to productivity, reliability and profitability can be met and even surpassed with the proposed system.

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