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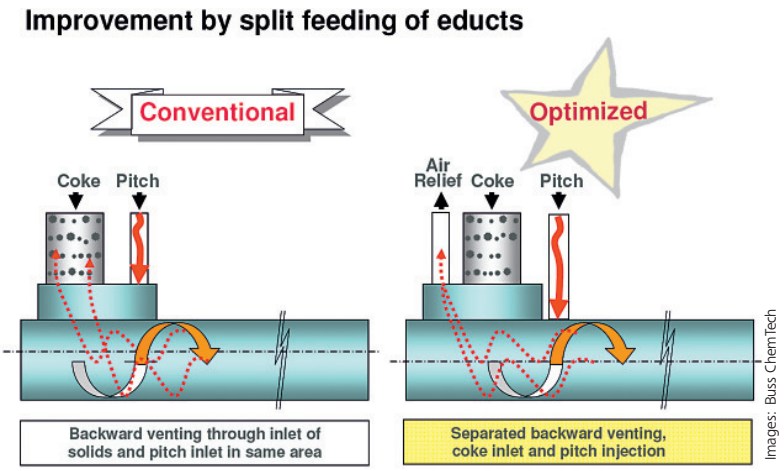
A kneader is a key equipment for producing of green paste for anodes out of petroleum coke and coal tar pitch. Kneaders are still the leading technology as the alternative solutions did not convince the carbon people in the aluminium industry. Although some alternative machinery claims to cost less in investment, would that compensate for a decrease in anode quality? But you may ask yourselves, "The BCT Paste Kneader was developed in the 1950s and has since been enhanced to match the developing needs of the industry; so what innovative improvements can still be expected?"



The requirements for anode paste production are unique and not comparable with those for other industrial carbon applications: kneading is neither extrusion nor a simple mixing process. The BCT Paste Kneader includes elements of both processes, and has been optimised in close collaboration with end users and technology partners. It combines in one operation many physical and mechanical processes within the machine which have been precisely identified and analysed. The process area has been adjusted correspondingly, so as to ensure a consistently good product, even coping with today's changing raw material properties, and smoothing fluctuations in input recipes.

The focus for development has always been to keep pace with the ongoing increase of production rates, so as to stay one step ahead of the smelters requirements. Since the early models there has been an enormous increase in smelter capacity. This required constantly increasing kneader sizes with longer process zones and bigger diameters, so as to process larger quantities with the same or even better paste quality results.

Nowadays

Scale up reaches its limit since further dimensional increase causes too many structural problems. Such machines place enormous static and dynamic loads for the buildings and they can only be transported and handled with very specialised equipment. Therefore they are not the right answer for an industry where plants are often built in remote areas, far away from the nearest city.

This sets severe limitations on developing a new generation of machines, and poses the question: How can we increase the process intensity within the given dimensions, and still avoid designing a logistical nightmare?

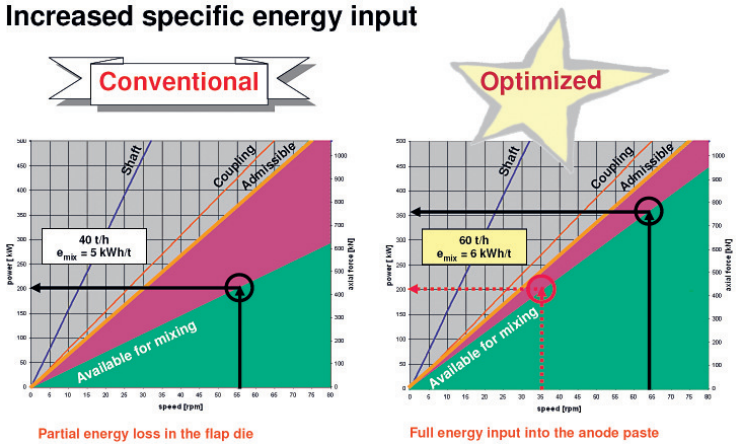
The BCT Paste Kneader K 600 CP seems to represent the maximum practical size so far. It has proved itself in the field with many successful installations, and is manageable in terms of installation, structural building requirements and maintenance.

Key design parameters for improved BCT Paste Kneader

• Overall machine dimensions	unchanged from K 600 CP
• Feeding of pitch	injected directly into process area
• Feeding of solid components	with back-venting ability for air
• Process sections	adapted to the present paste conditions
• Feed section for solid components	improved conveying efficiency
• Wetting and transition section	combine conveying and mixing
• Mixing and kneading section	improve conveying and kneading/mixing
• Dynamic throttling	self-regulating backpressure and energy dissipation
• Stroke	less inertial force, less deflection
• Gear box	reduced power peaks
• Specific energy	same level or higher than traditional
• Maintenance and wear	less wear, less frequent maintenance
• Investment	decreased specific cost per produced tonne

Yet we have still found opportunities for further improvements. Key design parameters for improved kneader are listed in the box. These developments led to the new kneader generation, the 'BCT Paste Kneader K600 CP_X'.

The process, now with harmonised geometries, corresponding to the density rise within the product, reaches the maximum conveying efficiency without sacrifying the mixing effect. In addition, optimised thrust flank angles now easily achieve the maximum barrel filling grade by variable and controlled shaft revolutions.



The Innovation: BCT Paste Kneader K 600 CP_X

The BCT Paste Kneader K 600 CP_X produces the well-known high quality standard paste, and does so reliably in continuous throughput of 60 tonnes per hour (production range 25 to 60 t/h). The outside dimensions of the kneader remain unchanged compared to its forerunner K 600 CP, since modifications mainly concern the internal parts of the machine.

The new BCT Paste Kneader processes up to 33% more throughput with the same good paste quality as the K 600 CP Paste Kneader thanks to several technical innovations:

1.) Feed of solid and liquid fraction to the barrel is split: the coke is still fed into the inlet opening of the kneader barrel, but the liquid pitch is now injected through one or several of the first kneading teeth, directly into the process area. This eliminates any accumulation of sticky material at the machine inlet, and it allows independent regulation of throughput by precisely matching shaft revolutions to the actual production rate. At the entrance the machine is provided with a separate vent for air and fumes (see diagram Improvement by split feeding of educts).

2.) New process zone: the kneading/mixing process compacts the paste so that its density rises from the beginning to the end of the barrel. This requires symmetrically distributed high process pressure and a constant filling level within the different areas. Suitable adjustment of the thrust flank angles in different process zones optimises both the kneading effect and the filling level. The new process zone now combines filling, dry compression, liquid pitch injection, mixing and kneading, conditioning/homogenisation and dynamic filling control, in one segment.

Detail of a BCT Paste Kneader

3.) Energy input control: throttling elements at the end of the process zone generate dynamic back pressure and replace the flap-die. Instead of increasing energy input by limiting the size of exit opening, we can now increase pressure by more efficient geometric means. This dynamic and 3-dimensional adjustment has been achieved by changes of the helix angle of this last process segment. It results in full energy input into the paste instead of partial energy loss in the flap-die. This reduces the concentration of mechanical load and so increases the machine's availability and reliability. See: controlled energy impact through 'constant torque control' in function of speed (see diagram Increased specific energy input).

4.) Increase of kneading/mixing steps: the number of kneading/mixing steps within the barrel has been increased, while still keeping the same overall size and the working diameter/length ratio.

5.) Service life: thanks to the optimised material inlet, to the re-designed process parts, and to the increased conveying effect, the BCT Paste Kneader generates a higher throughput at lower revolution rate. This noticeably reduces the wear of the kneading elements, increases service life and reduces maintenance frequency.

Such innovations are the fruit of decades of close cooperation with the major aluminium producers and research centres in the industry. They build on expertise gained in building complete anode plants, and this makes an essential contribution to developing more successful with innovative

products and to assuring continuous support for our clients.

The K 600 CP_X, as the newest member of the BCT Paste Kneader family, is the perfect extension to reach highest throughputs. It incorporates several innovations to increase the product quality and efficiency of the traditional BCT Paste Kneaders, K 500 CP and K 600 CP, which are still pacemakers in their capacity range.

A first K 600 CP_X will go into production during the first quarter of 2009. Further orders are already in final negotiation stage. Such quick success is the best driver for our highly skilled engineering and process team, and it proves that the right decisions have been made.

Author

Michael Kempkes is graduated mechanical engineer and Sales Manager for Buss ChemTech since 2005. He has held several sales positions during his career and is now in charge of General Sales Activities and Product Development, with focus on the Middle East region, and key accounts worldwide.

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