It will also develop new products, extend applications, promote economic prosperity and govern overall planning. The investigation shows that it is necessary for China to develop both new and special types of fibre.

At present, China is developing a superfine fibril for the production of efficient filtering materials to meet the needs of the electronic, chemical, instrument and meter industries. We have started to study carbon, fluon, Nomex, nickel-composite and silicon-carbide fibres as well as other new fibres. Filter cloth and other cloths for estate production made from such fibres will encourage further development of different industries.

Nonwoven fabrics

In recent years, nonwoven fabrics have developed rapidly in China. In 1989 the total output, second only to that of Japan, was 60 000 tons and this figure is increasing by 30% each year. China has also been exporting nonwoven products to more than 20 countries throughout the world. In 1990, 13 million square metres of cloth for earthwork applications (a type of nonwoven fabric) were consumed in road-building activities, immersion corrosion control and water drainage throughout the country. Estimates based on the growing demand and average annual rate of increase show that the production capacity of China's nonwoven fabrics will exceed 170 000 tons by the end of this century.

Trial manufacture of new products

It is important to enhance the trial manufacture of new products and extend their applications.

For example, the 729 polyester fibre cloth jointly developed by Shanghai No.33 Weaving Mill and the Design & Research Institute of Shanghai Baoshan Steel Complex is strong, has a small specific elongation, good heat-resistance, high dust-removal efficiency and a long service life and can be applied to dust separation at a steel or cement plant.

In the treatment of burner gas from an electric furnace installed at Shanghai No.3 Steel Works, the exhaust dust device fitted with a bag made from the 729 polyester fibre has replaced the bag made from the Japanese Nako cloth. The new product is beneficial to the producer, user and to the environment.

It is also necessary to improve the equipment used to manufacture industrial filter cloth, so that it is possible to produce stronger, wider, heat-resistant cloth and to implement post-manufacture processes.

In China, both imported and home-made large-size automatic filter presses, rotary-drum vacuum filters and belt presses are required to accommodate wide and high strength filter cloth. For instance, the Dandong Industrial Cloth Mill produces a heavy-duty filter cloth using imported equipment and looms for manufacturing wide cloth have been installed at more than 40 major filter cloth mills throughout the country, where the process flow is rationalised.

Industrial cloth with a width of 3 m is manufactured by Shanghai No.5 Canvas Mill and some of the highest quality heat-resistant and Nomex needle felts available in China, are made by the Fushun Weaving Mill and by the Shanghai No.1 Felts Manufacturing Factory respectively.

In China the textile industry is joining forces with the chemical industry, thereby increasing the variety and improving the quality of filter cloth and furthering the development of the filter cloth industries.

Letter from the USSR

By Alex Yelshin

Problems Associated with Filter Aids and Precoat Filtration

Although research and development work into filtration aids and precoat filtration is being carried out in the USSR, our correspondent feels that more effort is needed to solve the problems associated with this area of filtration.

Auxiliary filter aids play an important role in filtration technology. Their use, increases filtration productivity significantly and often improves the filtrate quality and longevity of filtering media, as well as solving the problems and difficulties associated with dewatering sludges and wastes.

The filter aids market in the west is relatively stable. The quality, quantity and variety of the filter aids satisfies the clients' demands. Accordingly the peak of scientific activity in the field of filtration research using filter aids as passed, though fundamental research is still going at the higher qualitative levels. However, the situation is different in the USSR. There are substantial deposits of diatomite and perlite on the SU territory, but only individual enterprises produce filter aids using these raw materials. Very often the main products of these enterprises are building materials that do not promote the quality of filter aids.

According to old rough estimates, deposits of perlite rock in the USSR total approximately 270 million m^3. The deposits of diatomites in particular diatomaceous earths are also considerable. None the less, the demand for filter aids is not being met and this also applies to the filter aid groups not mentioned above. The main problems of filter aid production are:

- ☐ Narrow range of the filter aids;
- ☐ Very often, a low quality in comparison with modern requirements for filter aids;
- ☐ Limited amounts of individual filter aid types being manufactured.

In an attempt to improve the quality of filter aids, mixtures of different types are used — primarily, the following: perlite and diatomite, perlite and/or diatomite and an adsorbent material or other combinations). Other improvements are effected by modifying the surface of the filter aid by treating it with chemicals. Despite this, the quantity and assortment of the filter aids produced is not satisfactory and is often made up by using sawdust, lignite and waste products like slag, crystalline substances or fibre mass.

Another way of improving the effective use of filter aids is by taking steps to perfect filtration technology. Here the solution can be sought in two ways:

- ☐ Empirical selection of the most effective types of filter aids to obtain a solid suspension or for given a technology;
- ☐ Investigating filtration theoretical bases to search for improved filtration processes together with better filter aids.

Methods of solving these problems, in particular the problem pertaining to precoat filtration is illustrated by the year long investigation undertaken by a leading specialist in this field: Dr Igor Leitshcis (The Ukrainian Academy of Sciences in Kiev). The main results of this work are presented in a monograph: I. M. Leitshcis *Filtration Using Filter Aids* - Kiev (1975), as well as in more than 80 other publications by the same author.

According to Leitschis the main points worthy of attention are: The search for

a common approach to precoat filtration based on a definite scientific concept, making sure that the descriptions of liquid purification on precoat filters are clear and determining the contribution of different process parameters to the filtration effectiveness.

Also of importance are investigations of precoat filtration as a stochastic process and the development of the recommendations for the industry of apparatuses and technology application, and filtration optimisation.

The main achievement of precoat filtration on the basis of these principles can be formulated as follows:

- The retention of particles during filtration is achieved by the precoat layer, by mechanical and/or absorption means and evaluation criteria for the contribution of each factor during filtration has to be determined.
- For the absorption mechanism, the interactional forces which balance the particle-precoat phase have to be determined, as do the hydrodynamic forces which govern the return of particles into the liquid being filtered. The particular conditions relating to the return of retained particles to the flow, and the critical filtration velocity dependent upon the electro-kinetical potential of the suspended and filter aid particles have to be determined.
- When filtration through the precoat layer is analysed from the standpoint of the stochastic process, it has been shown that the mechanical retention of suspended particles in the precoat layer at constant rate filtration is described by the stationary Poisson process; with constant pressure filtration being described by the non-stationary Poisson process. The absorption filtration mechanism through the precoat layer is modelled on the Markov *birth-death* process. On this basis the action of the non-uniform precoat layers is shown to be absorption filtration.
- The necessary conditions for optimum filter aid use are determined in terms of the optimum concentration of filter aids added to the slurry, as well as the optimum filtration area for cost minimisation per unit of filtrate volume.
- Filter aids based on crystallised cellulose and those fabricated from composites as well as associated technology are evaluated.
- The effective construction parameters of leaf precoat filters are determined and are taken into consideration when evaluating vertical leaf filters with a filtration area amounting to 250m^2.

Similar investigations into filtration using filter aids are continuing at other laboratories in the USSR.

Despite the successes in the theory and technology of filtration, industrial processes demand filter aids which can give both a high and a stable quality of filtrate at maximum productivity.

As stated earlier, the USSR requires companies which specialise in the production of filter aids for potable and process water, for food, pharmaceuticals and for filtration in the chemical industry. Foremost among the urgent problems is that of producing filter aids for the treatment of industrial waste water which would then make possible the treatment or destruction of solid waste products obtained through filtration at minimum economical and ecological costs.

Such filter aids in the filtered water should be inert, but be able to interact actively with the filtered solid phase during the further treatment of hazardous materials or the destruction (for example burning) by the neutralisation of the harmful factors that arise.