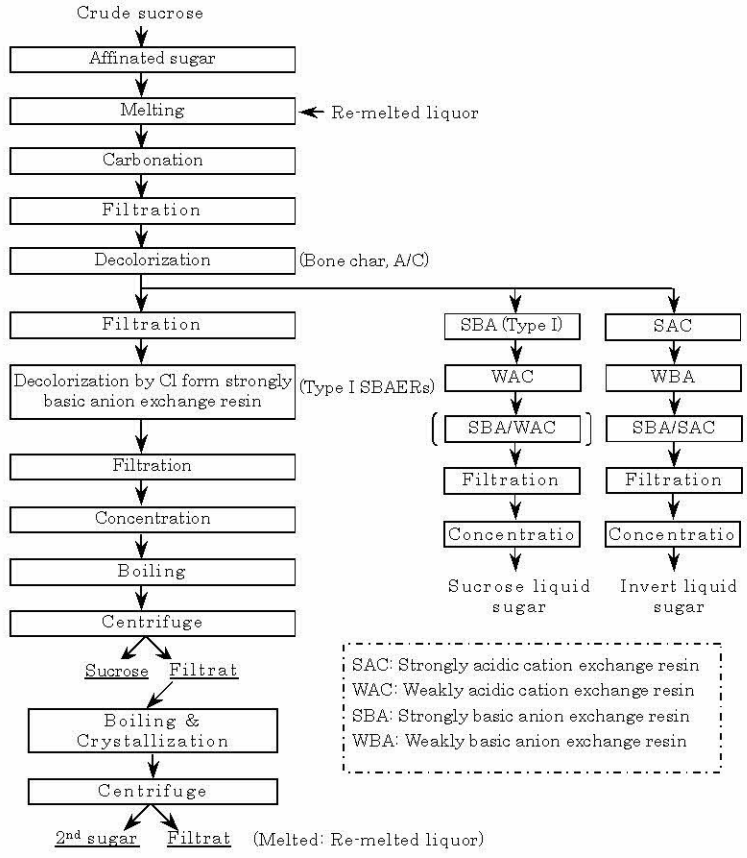
Refining of Cane Sugar

(Extracted from the Diaion Manuals pages 257 to 261)

Chapter VIII Foods and Food Additives

1. Refining of Cane Sugar

The largest and most traditional use other than water treatments is the refining of cane sugar. There are three kinds of sucrose: the first one is cane sugar made from sugar canes, the second one is beet sugar from sugar beets and the last one is liquid sugar that is traded in liquid. All three kinds of sucrose are refined with IERs.

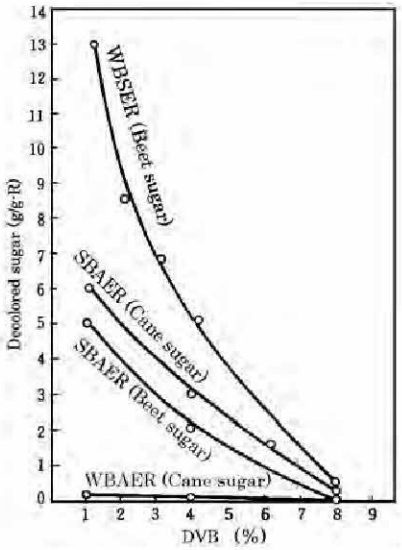


[Fig.VIII-1-1] Refining process of Sucrose liquor

(1) Refining of Cane sugar

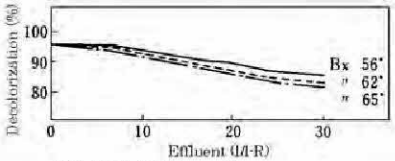
Domestic sugar canes are cultivated only in Okinawa and some part of Kyushu District. Thus, most of cane sugar in Japan is the refined product of the imported crude cane sugar. Crude cane sugar is made by the following procedures: a) limemilk is added to the squeezed solution from sugarcanes and the liquor pH is adjusted to 7.0 ~7.5, b) filtrate at high temperatures to remove organic impurities and c) concentrate the filtrate. Imported crude cane sugar is refined as illustrated in Fig.VIII-1-1.

The washed sugar liquor holds polymeric organic non-sugar impurities colored ingredients. These polymeric organic non-sugar and colored impurities are removed by carbonation and IER treatment, respectively. There are very many colored ingredients in the raw liquor, and most of them are polar and thus can be adsorbed by IERs.

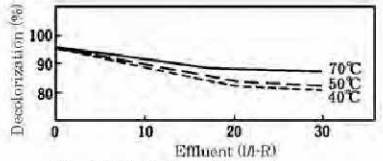


[Fig.VIII-1-2] DVB vs. Decolorization of AERs[65]

AERs of low crosslinkage are efficient adsorbents to these colored materials. Fig.VIII-1-2 summarizes decolorization results with several kinds of AERs of different crosslinkages and it lets us know that the lower is crosslinkage the more effective is decolorization.



[Fig.VIII-1-3] Sugar liquor conc. vs. Decolorization in Cl decolorization [66]

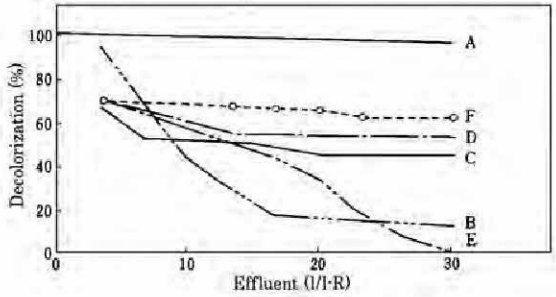


[Fig.VIII-1-4] Sugar liquor temp. vs. Decolorization in Cl decolorization [66]

Treatment with Cl-form SBAERs, e.g. SAF11AL and PAF308L, after activated carbon, abbreviated as "A/C" below, treatment can remove the impurities that cannot removed with A/C. This method is widely applied in most factories of sugar refining, and is abbreviated as decolorization by Cl-form SBAER.

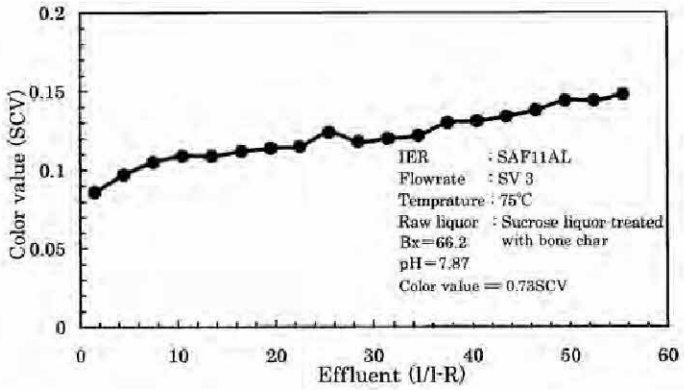
Cl-form IERs make it possible to treat raw liquor at high temperatures, 70 ~80 °C, and can replace SO_4^{2-} anions by Cl^- anions to prevent scale formation. The major results in research reports [66] on decolorization by this method are illustrated in Figures VIII-1-3 thru VIII-1-5.

Figures VIII-1-3 thru VIII-1-5 demonstrate the correlation of decoloring percentage with liquor concentration, liquor temperature and synthetic colorants, respectively. Decolorization of sucrose liquor by decolorization by Cl-form SBAER is illustrated in Fig.VIII-1-6.

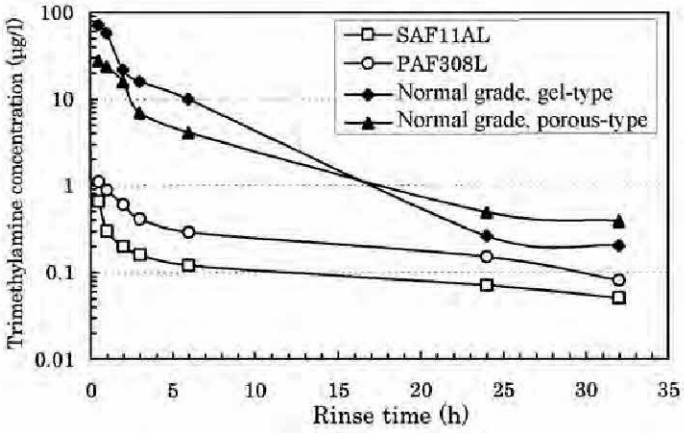


[Fig.VIII-1-5] Removals of colorants with Cl-form AERs[66]

A: Alkaline decomposed colorants from glucose at low temp. (Commercial glucose added with NaOH is heated at 100 ~110°C 1h, mixed with granulated sugar liquid (Brix60), SCV 4.3)
B: Caramel colorants (Commercial caramel is melted as A, SCV 2.4)
C: Alkaline decomposed colorants from glucose at high temp., treated as A: at 120 ~130°C 1h, SCV 4.0)
D: Textile yellow colorant (Add NaOH solution to sugar cane fibers, extract yellow colorants at 100 °C, treat as above, SCV 0.99)
E: Tannic acid (Commercial tannic acid is treated as above, SCV 1.2)
F: Chlorophyll (Commercial Chlorophyllin is treated as above, SCV 1.2)



[Fig.VIII-1-6] Decolorization of Sucrose liquor by Cl-form SBAER [67]



[Fig.VIII-1-7] Rinsing properties of F-series vs. standard grades

AERs that are used for a long time in chloro- decolorization process lose their decolorization function to a large extent. Such AERs cannot be regenerated sufficiently with NaCl solutions. Thus, they should be resurrected. Rejuvenation is effective while the AERs are not contaminated much, and thus it is normally performed once per 30 ~50 cycles.

The selection of AERs and the preparation are important in decolorization operations. Typical properties of raw sugar liquor into IER towers, which are already treated by carbonation and A/C decolorization, are written

below: Color value is around one SCV (Stanmer color value), Brix (sugar concentration) is 55 through 65 and temperature is 70 ~80 °C.

F-series AERs, e.g. SAF11L and PAF308L, with low amine- elution are applied for this decolorization process. Fig.VIII-1-7 demonstrates their differences from normal grades.