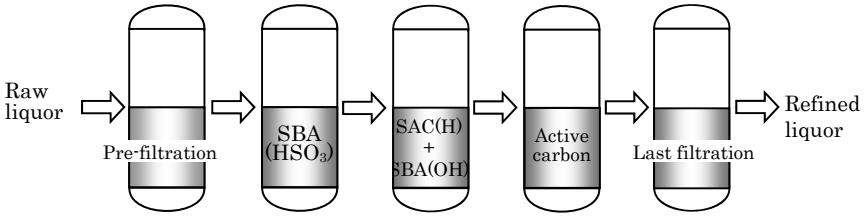
Refining of Alcohols

(1) Refining of Shochu

Recent consumers need better taste of foodstuffs than before, and thus alcohols are also needed to have good tastes in accordance with such general trends. Shochu is categorized into three groups: the first one is "Koh-rui", continuous distillation product after fermentation of sugar and starch in sugar syrup, potatoes and grains, the second one is "Otsu-rui" manufactured by a) making mash from rice with malt or yeast, b) mixing mash with steamed rice, wheat or buckwheat, c) alcohol fermentation and d) batch distillation, and the last one is "kasutori shochu" made from sake lees. The flavors of Koh-rui are nearly the same as pure ethanol. Thus, refining of Otsu-rui is explained in the following clause.

Shochu flavors vary from status of mash, maturation and distillation process. Organic acids, organic acid esters, aldehydes, fusel oil and furfural constitute the flavors, and thus the concentrations of these compounds affect the smoothness, bitterness, irritating odor and aroma.



[Fig.VIII-5-1] Refining process of Shochu spirits

Aldehydes, organic acids and organic esters that cause nasty or unpleasant smell can be removed with IERs to improve flavors. Refining process is illustrated in Fig.VIII-5-1: 1) Pre-filtration is to remove small particles to protect contamination of IERs, 2) SBAERs, e.g. SA11A, are already treated with $NaHSO_3$ solution to be in sulfurous-form, 3) aldehydes and ketones are adsorbed by IERs as shown in the following reactions, 4) IERs are regenerated with NaCl solutions and then with $NaHSO_3$ solutions.

$$R \cdot NCl + NaHSO_3 \cdot R \cdot NHSO_3^- $$

$$R \cdot NHSO_3 + R'CHO \cdot R \cdot NHSO_3OHCR'$$

$$R \cdot NHSO_3 + R'_2CO \cdot R \cdot NHSO_3OCR'_2$$

H-form SACERs, e.g. SK1B, and OH-form SBAERs, e.g. SA10A, are used in mixed-bed systems. Organic materials, some esters, metal ions, e.g. iron and calcium, brought from the preceding processes and mineral acid anions that leak from SA11A are removed by the mixed-bed system to produce highly refined shochu.

$$2RSO_3H + FeCl_2 \cdot (RSO_3)_2Fe + 2HCl$$

$$R \cdot N\text{-}OH + HCl \rightarrow R \cdot NCl + H_2O$$

Used CERs and AERs are regenerated with HCl and NaOH solutions respectively, and then reused.

Coconut husk carbons, used as A/C, adsorb nasty smell materials in a little quantity, e.g. amines. The last filtration is to remove the contaminated small particles finally. Table VIII-5-1[76] summarizes the treatment results of rice shochu, wheat shochu and buckwheat shochu with SA11A, mixed-bed system of SK1B(H) and SA10AP(OH) and A/C (DIAHOPE 006).

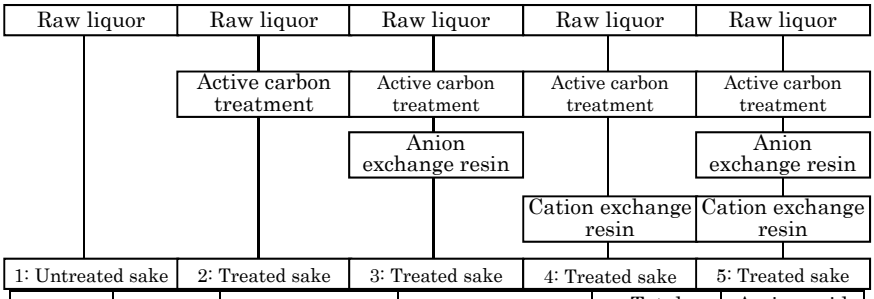
[Table VIII-5-1] Refining of Shochu[76]

Process flow: SA11A (HSO_3-form) → SK1B/SA10AP(MB)→ granular A/C

		pH [−]	Electric conductivity [mS/m]	Aldehyde [mg/L]	Ca [mg/L]	Mg [mg/L]
Rice shochu	Raw	4.53	105	55.5	0.16	0.10
	Refined	6.04	39.6	4.8	0.05	0.01
Wheat shochu	Raw	4.68	655	51.5	0.11	0.03
	Refined	5.92	15.2	6.2	0.08	0.01
Buckwheat shochu	Raw	4.22	175	75.8	0.14	0.05
	Refined	5.82	27.8	7.6	0.07	0.01

(2) Refining of Japanese Sake [77]

Demand for Japanese sake has been stagnant, whereas that for shochu that can be tasted with water, hot water and carbonated water is increasing year by year. Organic acids, e.g. lactic acid, succinic acid and malic acid and amino acids in raw sake are eliminated with IERs to produce smooth-taste sake without losing original tastes and flavors. Raw sake is manufactured by the following steps: 1) steaming white rice, 2) making malt from some portion of steamed rice, 3) making yeast mash from steamed rice, malt and water, 4) preparation of mash: adding steamed rice, malt and water to mash, 5) Filtration. Fig.VIII-5-2 compares the raw sake property with that treated by various refining methods: No.5 treated by A/C, H-form SACER and Type I OH-form SBAER has better results and has smoother tastes than original raw sake with decreases of total acidity, amino acids and other organic acids, e.g. citric acid.



	Glu(%)	Degree of sake	Ethanol content	Total acidity	Amino acid content
1	1.84	+6.7	20.1	1.65	1.95
2	1.84	+6.5	20.0	1.65	1.95
3	1.52	+8.7	18.4	0	0.20
4	1.61	+7.8	18.7	2.45	0.45
5	1.59	+8.6	17.4	0.25	0.10
Shochu	-	+44.9	25.4	0.00	0.00

[Fig.VIII-5-2] Refining process of Japanese sake and its results [77]

(3) Refining of Wine

Wine is manufactured as follows: 1) Crushing of grapes, 2) Pour grape juice in fermentation vessels , with pericarps and seeds in the case of red wine, 3) fermentation for 10 ~20 days with wine yeasts, 4) maturation in barrels. Wine is consumed not only for beverages but also for cooking of fish and meats. It includes organic acids, e.g. tartaric acid, malic acid, lactic acid and succinic acid, that are derived from grapes and generated in fermentation and maturation, and thus it is treated with AERs, e.g. WA20, WA21J, WA30 and SA10A, to decrease acid contents and to adjust its pH to 4.5 ~7.0. Such wine is suitable for cooking, since the cooked materials are kept soft and have good flavors with some gloss. [78]

Organic acids in grape juice are removed with AERs during fermentation, and then the fermentation period can be shortened and better wine with balanced acidity and bitterness can be produced. [79] This process can be applied for highly acidic fruit juice that could not be used to produce wine. Wine can be produced from such acidic juice that is de-acidified with AERs, as already explained at clause 4. [80]