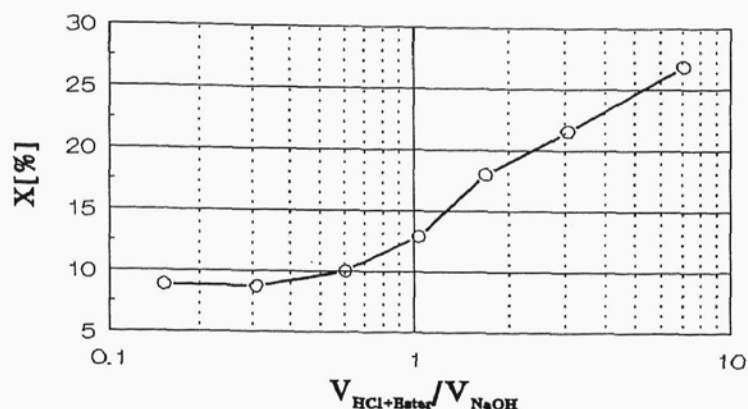


Figure 8.6 shows that the effect of the initial volume ratio on the product distribution is strong; change of the volume ratio from 7:1 to 1:7 decreases the selectivity 3 times. This indicates that mixing in the batch reactor can be significantly improved by using larger volume of the less concentrated base solution and smaller volume of the more concentrated acid and ester solution.



**Figure 8.6. Effect of the initial volume ratio on the final selectivity in the batch reactor - experimental results.**

### 8.2.3. Effect of the Viscosity Ratio on the Product Distribution.

The third series of the experiments was conducted to find how the difference in viscosity of mixed solutions influence the product distribution. During these experiments viscosity of the acid and ester solution was constant, whereas the viscosity of the base solution was changed from one experiment to another. The initial distribution of the solutions was identical as in the first series of tests (one eighth of the gap occupied by the base solution). In all the experiments the revolution speed was equal to 10 rev/min. The experiments were carried out at 18°C. Tables 8.IIIabc present compositions, volumes, viscosities and densities of solutions together with the final selectivities. These results are compared with the result obtained when mixing liquids of equal viscosity (exp.no. 2 in tables 8.Iabc) in figure 8.7.

**Table 8.IIIa. Third series of tests - the acid and ester solutions;  $w_p=42\%$ ,  $n=10$  rev/min.**

Exp.no.	HCl [mol/dm <sup>3</sup> ]	Ester [mol/dm <sup>3</sup> ]	V [dm <sup>3</sup> ]	$\rho$ [g/cm <sup>3</sup> ]	$\mu$ [Pa·s]	KCl [g/kg]
1	0.01430	0.01324	1.734	1.0889	0.4922	32.40
2	0.01412	0.01341	1.743	1.0822	0.4873	21.83
3	0.01391	0.01413	1.735	1.0684	0.5209	0.0
4	0.01391	0.01413	1.748	1.0684	0.5209	0.0
5	0.01396	0.01329	1.738	1.0693	0.5276	0.0

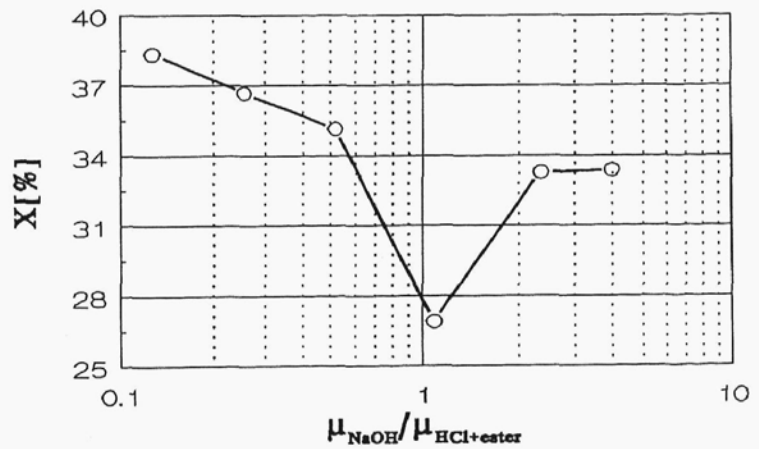
**Table 8.IIIb. Third series of tests - the base solutions;  $n=10$  rev/min.**

Exp.no.	$w_p$ [%]	NaOH [mol/dm <sup>3</sup> ]	V [dm <sup>3</sup> ]	$\rho$ [g/cm <sup>3</sup> ]	$\mu$ [Pa·s]	KCl [g/kg]
1	54.0	0.09840	0.2475	1.0889	1.956	0.0
2	49.0	0.09945	0.2451	1.0824	1.142	0.0
3	36.0	0.09970	0.2483	1.0685	0.2695	9.360
4	30.0	0.09933	0.2534	1.0680	0.1333	24.83
5	24.0	0.09897	0.2458	1.0688	0.0664	40.53

**Table 8.IIIc. Third series of tests - final solutions after experiment;  $n=10$  rev/min.**

Exp.no.	Ester [mol/dm <sup>3</sup> ]	X[%]	V [dm <sup>3</sup> ]	$\rho$ [g/cm <sup>3</sup> ]	$\mu$ [Pa·s]
1	0.007493	33.13	1.988	1.0821	0.5246
2	0.007694	33.29	1.981	1.0891	0.5518
3	0.007978	35.14	1.984	1.0681	0.4563
4	0.007735	36.67	2.002	1.0681	0.4327
5	0.006940	38.33	1.983	1.0686	0.4083

Figure 8.7 shows that either increasing viscosity ratio above one or decreasing it below one raises the final selectivity. The results are similar to that obtained for the semi-batch reactor. In the present case, it is even more clear that the microflow instabilities are responsible for retarding the process of thinning of the solution layers. After a



**Figure 8.7. Effect of the viscosity ratio on the final selectivity in the batch reactor - experimental results.**

few revolutions of the inner cylinder, the striations become tangentially oriented and one should expect a small influence of the viscosity ratio on the process of reduction of segregation scales. Although it is possible that for longer mixing times differences in

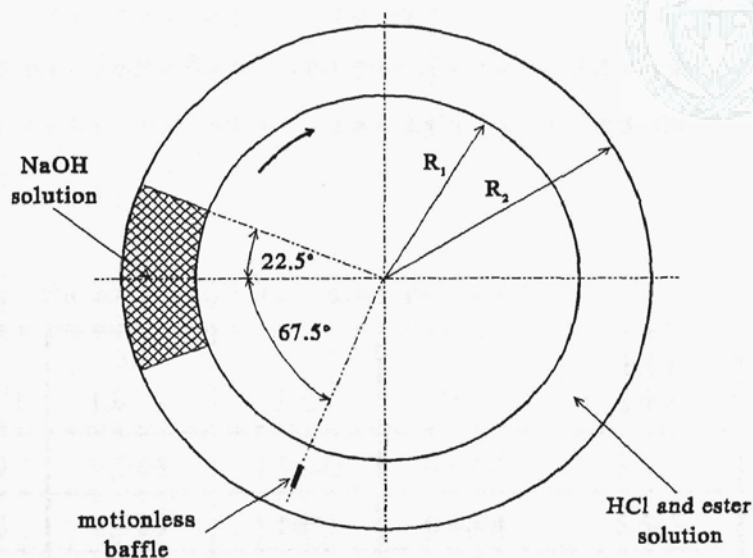
viscosities of mixed solutions may cause their segregation due to inhomogeneity of the shear rate in the gap; visual observations made during these experiments showed that this effect was hardly detectable. Instead, formation of small vertical vortexes (low viscosity ratio) and spots of different size (high viscosity ratio) was detected; these structures were similar to that observed by Murakami et al.[24] in a cone-plate mixer.

#### 8.2.4. Effect of a Local Disturbance of a Unidirectional Couette Flow on the Product Distribution.

The shear flow produced in the annular gap between the cylinders tends to orient intermaterial surfaces along direction of shear. When it happens, both the rate of growth of the surface area and the rate of thinning of reactant layers drop to zero. To prevent this happening one should try to reorient the solution layers in the direction of the fastest stretching in the shear flow; this direction is deflected 45 degrees from the direction of shear - see discussion in chapter 3.1.

Two attempts were undertaken to modify the experimental system in such a way as to achieve a local reorientation of the shear flow in the annular gap.

In the first case (fourth series of experiments) 5.5 mm wide and 2 mm thick plate, extending between the bottom and the top cover of the reactor, was inserted in the middle of the annular gap. The baffle was made of stainless steel. The initial distribution of the substrates solutions and position of the plate are shown in figure 8.8. After filling the gap with solutions, rotation of the inner cylinder was initiated and



**Figure 8.8. Initial distribution of the substrates solutions and position of the baffle in the gap.**

kept constant for one hour. The experiments were conducted at 22°C. Tables 8.IVabc present compositions, amounts, viscosities and densities of solutions, together with rotational speeds and the final selectivities.

In the second case (fifth series of experiments) a small, six-blades turbine, made of brass, was