Supplementary Information for
Abiotic streamers in a microfluidic system

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\textbf{Figure S1}: Schematic of the preparation of polymer solution at room temperature. 1g of polymer powder were mixed with 500mL of normal tap water (0.2% w/w PAM solution) and mixed at 600 rpm for at least 3 hours to ensure homogenization.
Table S1: Properties of PAM. (* For 0.2% solution obtained from bulk rheology)

<table>
<thead>
<tr>
<th>Weight average molar mass, $M_w$ (g/mol)</th>
<th>Number average molar mass, $M_n$ (g/mol)</th>
<th>Polydispersity index (PDI)</th>
<th>Radius of gyration, $R_w$ (nm)</th>
<th>Relaxation time scale, $\lambda$ (s)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>$2.26 \times 10^6$</td>
<td>$7.6 \times 10^6$</td>
<td>2.96</td>
<td>191.9</td>
<td>2.07</td>
</tr>
</tbody>
</table>

Figure S2. AF4 analysis of different molar mass fraction, differential and cumulative molar mass distribution of PAM (0.2% w/w) solution at room temperature. The weight average molar mass, $M_w$, was $2.26 \times 10^6$ g/mol.
Figure S3. AF4 fractograms of PAM (0.2% w/w) solution showing differential radius and cumulative radius distribution at room temperature. It indicates the small presence of high radius polymer molecules with leading presence of radius $R_w \approx 191.9$nm.

Figure S4: Control experiments for the investigation of streamer formation confirms that streamer forms for the combined flow of PAM (0.2% w/w) and PS (0.1%w/w) solution only.
Figure S5. Different morphology of streamer formation at various pH values. Streamers formed after one hour for $Q_{PAM}=10\mu$L/h and $Q_{PS}=30\mu$L/h at (a) pH=4 and (b) pH=9.

Figure S6: (Left) SEM image of a floc (Right) SEM Image of a streamer fragment. The SEM imaging was done for a mixing volume ratio (PAM:PS) of 1:4 at pH 5 for the floc and flow rate $Q_{PAM}=10\mu$L/h and $Q_{PS}=40\mu$L/h for the streamer experiment.
**Figure S7**: Zeta potential of anionic PAM (0.005%) as a function of pH.

**Sample calculation for Weissenberg number:**

\[ Wi = \lambda \dot{\gamma} = \lambda \frac{U}{L} \]

where \( \dot{\gamma} \) is the shear rate, \( U \) is the velocity scale and \( L \) is the length scale. One condition when streamer formation occurs is \( Q_{PAM} = 5 \mu L/h \) and \( Q_{PAM} = 10 \mu L/h \). This yields \( U = 7.4 \times 10^{-5} \) m/s. Using \( L = 50 \times 10^{-6} \) m and using the relaxation time scale obtained from bulk rheology (Fig. 2) we get \( Wi \approx 3 \).

**Supplementary video**

**Supplementary video 1**: Video shows viscous abiotic streamer formation for short time scale and elastic abiotic streamer formation for long time scale. Video runs at real time and scale bars are 50\( \mu \)m.