RSC | Advancing the Chemical Sciences

Shewart Chart Example

A plastics company manufactures polystyrene using a living polymerization process to give a narrow distribution of molecular weights. The number average molecular weight (M_n) of each batch of polystyrene is determined using four repeat measurements. Analysis data from fifteen batches of polystyrene are listed in the Table below.

	Number average molecular weight (M_n) / kg mol^{-1}					
Polystyrene Batch Number	Measurement 1	Measurement 2	Measurement 3	Measurement 4	Mean / kg mol^{-1}	Standard Deviation / kg mol^{-1}
1	186	190	180	177	183	5.9
2	175	187	182	174	179	3.0
3	172	174	163	171	170	5.1
4	168	179	197	187	183	12.3
5	173	172	177	190	178	8.3
6	197	187	169	210	191	17.3
7	199	196	190	178	191	9.3
8	211	196	199	197	200	6.9
9	195	184	203	205	197	9.5
10	191	191	186	185	188	3.2
11	181	195	184	180		
12	186	188	169	182		
13	179	186	166	176		
14	186	174	163	182		
15	186	177	189	167		

(a) The last five batches (11 to15) are typical of the polymerization process when it is running according to specification and in statistical process control. Calculate values for the mean and standard deviation for each of the last five batches of polystyrene to complete the data table. Using these values, determine a long term process mean and process standard deviation.

(b) Construct a Shewhart control chart for the mean M_n data.

(c) From your Shewhart chart, state every batch number when the manufacturing process would have deemed to have gone out of statistical control. State the reasons for your decisions.