

KAWASAKI STEEL TECHNICAL REPORT

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Ironmaking Technology, Secondary Refining,
and Center-Segregation Control with Forging in CC

Concept of Continuous Forging Process and Experimental Analysis of Forged Blooms

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Synopsis :

With a view to substantially improving centerline segregation, the authors developed the continuous forging process, based on a completely new solidification mechanism. In the new method, the unsolidified bloom is subjected to heavy reduction at the stage of final solidification by anvils installed in the strand line. The effectiveness of the method has been confirmed using commercial continuous bloom casters, where it was found that centerline segregation can be eliminated and the segregation ratio of carbon C/C_0 can be controlled to an aimed value between 0.6 and 1.0 by choosing an appropriate ratio of reduction to the unsolidified thickness. It was also found that semi-macro segregation can be reduced and internal quality is quite stable in spite of deviations in casting conditions during actual operation.

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The body can be viewed from the next page.

Concept of Continuous Forging Process and Experimental Analysis of Formed Blows*

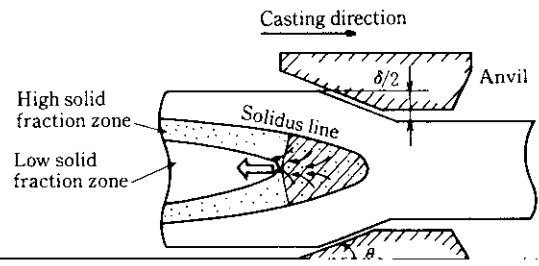
Synopsis:

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2 Concept of Continuous Forging Process

2.1 Mechanism of Centerline Segregation in Continuous Casting

Steel includes C, Si, Mn, P, S, and other non-ferrous metal and nonmetallic components and demonstrates a



together with the results for δ_1 . This δ_2 shows the

occurs when the amount of center-area reduction is

all the solid phase in the apparent unsolidified begins when the amount of reduction exceeds the

internal cracking, even under high reduction, by forming a compressive stress field. In addition, there are few

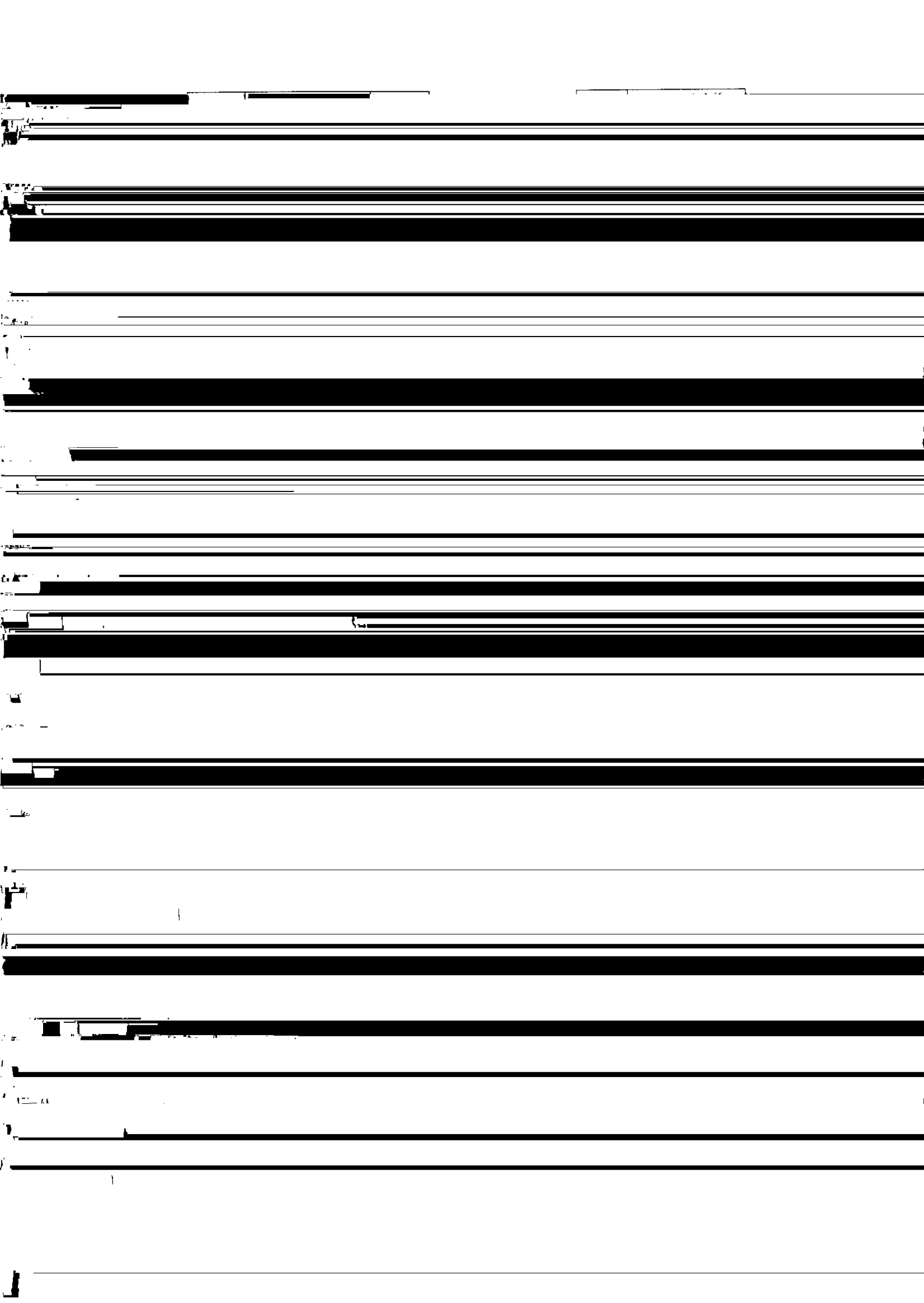
is possible without either internal or surface cracks, provided appropriate forming conditions are used.

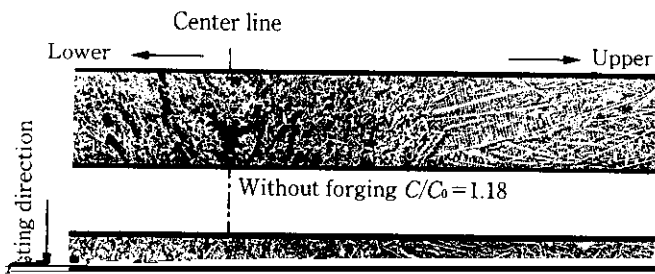
problem of transmission of stress waves through the material.

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Table 2. Experimental conditions of each trial.

Trial	Condition	Duration	Frequency	Intensity
1	Control	10 min	1x	Low
2	Control	10 min	1x	Low
3	Control	10 min	1x	Low
4	Control	10 min	1x	Low
5	Control	10 min	1x	Low
6	Control	10 min	1x	Low
7	Control	10 min	1x	Low
8	Control	10 min	1x	Low
9	Control	10 min	1x	Low
10	Control	10 min	1x	Low
11	Control	10 min	1x	Low
12	Control	10 min	1x	Low
13	Control	10 min	1x	Low
14	Control	10 min	1x	Low
15	Control	10 min	1x	Low
16	Control	10 min	1x	Low
17	Control	10 min	1x	Low
18	Control	10 min	1x	Low
19	Control	10 min	1x	Low
20	Control	10 min	1x	Low
21	Control	10 min	1x	Low
22	Control	10 min	1x	Low
23	Control	10 min	1x	Low
24	Control	10 min	1x	Low
25	Control	10 min	1x	Low
26	Control	10 min	1x	Low
27	Control	10 min	1x	Low
28	Control	10 min	1x	Low
29	Control	10 min	1x	Low
30	Control	10 min	1x	Low
31	Control	10 min	1x	Low
32	Control	10 min	1x	Low
33	Control	10 min	1x	Low
34	Control	10 min	1x	Low
35	Control	10 min	1x	Low
36	Control	10 min	1x	Low
37	Control	10 min	1x	Low
38	Control	10 min	1x	Low
39	Control	10 min	1x	Low
40	Control	10 min	1x	Low
41	Control	10 min	1x	Low
42	Control	10 min	1x	Low
43	Control	10 min	1x	Low
44	Control	10 min	1x	Low
45	Control	10 min	1x	Low
46	Control	10 min	1x	Low
47	Control	10 min	1x	Low
48	Control	10 min	1x	Low
49	Control	10 min	1x	Low
50	Control	10 min	1x	Low
51	Control	10 min	1x	Low
52	Control	10 min	1x	Low
53	Control	10 min	1x	Low
54	Control	10 min	1x	Low
55	Control	10 min	1x	Low
56	Control	10 min	1x	Low
57	Control	10 min	1x	Low
58	Control	10 min	1x	Low
59	Control	10 min	1x	Low
60	Control	10 min	1x	Low
61	Control	10 min	1x	Low
62	Control	10 min	1x	Low
63	Control	10 min	1x	Low
64	Control	10 min	1x	Low
65	Control	10 min	1x	Low
66	Control	10 min	1x	Low
67	Control	10 min	1x	Low
68	Control	10 min	1x	Low
69	Control	10 min	1x	Low
70	Control	10 min	1x	Low
71	Control	10 min	1x	Low
72	Control	10 min	1x	Low
73	Control	10 min	1x	Low
74	Control	10 min	1x	Low
75	Control	10 min	1x	Low
76	Control	10 min	1x	Low
77	Control	10 min	1x	Low
78	Control	10 min	1x	Low
79	Control	10 min	1x	Low
80	Control	10 min	1x	Low
81	Control	10 min	1x	Low
82	Control	10 min	1x	Low
83	Control	10 min	1x	Low
84	Control	10 min	1x	Low
85	Control	10 min	1x	Low
86	Control	10 min	1x	Low
87	Control	10 min	1x	Low
88	Control	10 min	1x	Low
89	Control	10 min	1x	Low
90	Control	10 min	1x	Low
91	Control	10 min	1x	Low
92	Control	10 min	1x	Low
93	Control	10 min	1x	Low
94	Control	10 min	1x	Low
95	Control	10 min	1x	Low
96	Control	10 min	1x	Low
97	Control	10 min	1x	Low
98	Control	10 min	1x	Low
99	Control	10 min	1x	Low
100	Control	10 min	1x	Low





carbon segregation at the bloom center shows little

A continuous forging method was developed with the aim of improving centerline segregation in continuously cast blooms. In this method, anvils are used to apply

gation remained virtually unchanged with fluctuations in casting speed equivalent to an approximately 1 min stop of casting, confirming the stability of