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Fatigue failure of a bar of a twin-screw extruder for plastics

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Abstract

The paper deals with the analysis of the failures regarding one of the bars of a twin screw extruder for plastics and reinforced plastics. The extruder was equipped with an 50 kW electric motor and very soon showed failure problems, always on the same bar, that was substituted many times. The analysis of the material, tensile tests and fractographical observations of some broken bars helped to understand that failures were due to fatigue and to define some design improvements of the bar. In-service strain gauge measurements were executed to assess the actual load acting on the bars and the data were elaborated by using the spectral analysis approach and were used to assess the fatigue strength of the bars.

Keywords: Plastics extruder; Fatigue failure; Spectral analysis

1. Introduction and description of the system

A twin-screw extruder for plastics, similar to many others that regularly works for many years, was put in service: very soon showed failure problems of one of the two bars. The latter was frequently substituted, but the problem was not solved. On the contrary the other bar continued to work without any problem. The extruder was disassembled and some parts of the gearbox connecting the motor to the bars were changed. But the problem persisted, always on the same bar. It was decided to look in depth at this case, to understand the reason of this particular behaviour.

In Fig. 1 the extruder is shown together with its schematic drawing: it is constituted by a 50 kW electric motor connected to a gearbox and, finally, to two co-rotating bars, connected to the two-lobes screws by involute spline connections. The connection between the gearbox shafts and the bars is also made with

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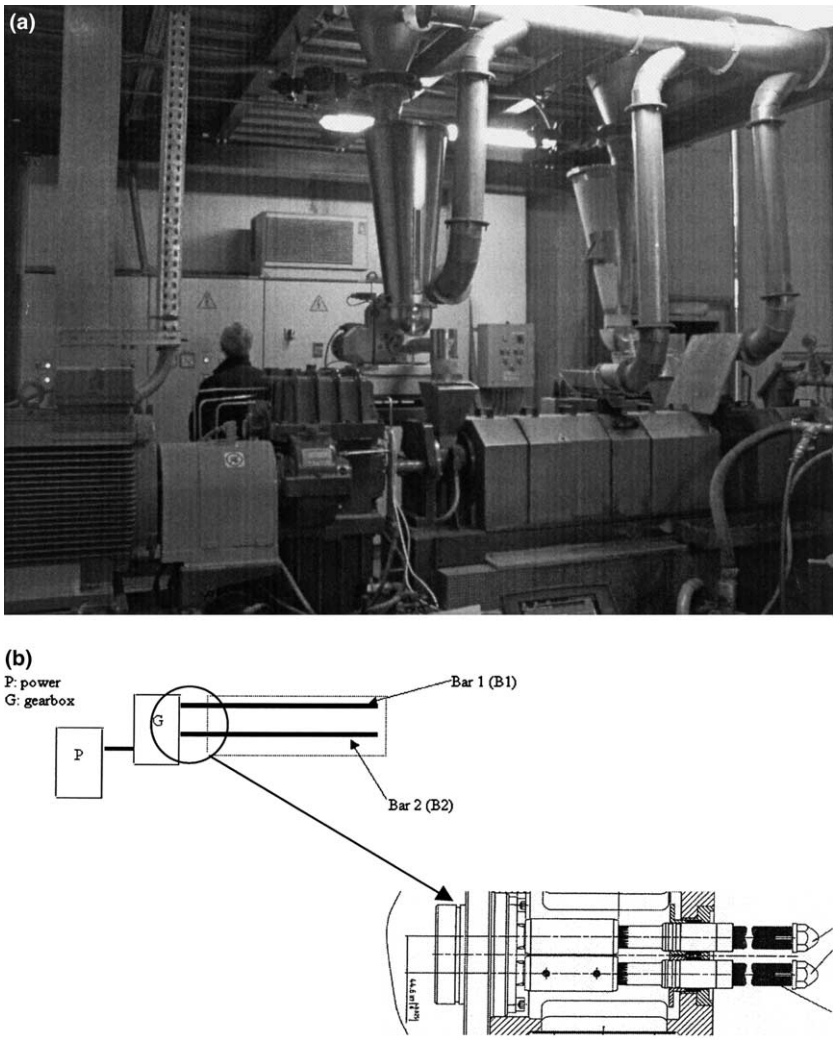

Fig. 1. Picture of the twin screw extruder (a) and its schematic layout (b).

involute splines: two splined sleeves are used to connect gearbox-shafts and bars (see Fig. 1). In Fig. 2 the drawing of the splined part of the bar (spline type: ASA 24/48) is shown. In the same figure it is possible to note the seat for the pin used to axially lock the bar. Even if it cannot be noted in the drawing, a tooth was removed from the bar to make easier assembly.

The screws and the bars are included in cylindrical bodies, that have an apposite internal geometry to enable the screws to extrude plastics.

The motor is an asynchronous electric one: a control system prevents overloads by stopping it, in the case that the required torque is too much.

The layout of the gearbox (gear ratio = 2.4) is able to minimize the reaction on the supports, allowing to choose smaller bearings and making work conditions of the two bars apparently analogous.

Indeed, very soon after the extruder began to work, bar B2 (Fig. 1) failed, and after it was substituted, other unexpected failures took place. On the contrary, bar B1 kept on working without problems. The