Dust driven mass loss from carbon stars as function of stellar parameters - II. Effects of grain size on wind properties

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[Abridged] In this paper we explore grain size effects on wind properties of carbon stars, using a generalized description of radiative cross sections valid for particles of arbitrary sizes. The purpose of the study is to investigate under which circumstances the small particle limit (SPL) may give acceptable results, and to quantify the possible errors that may occur when it does not hold. The time-dependent description of grain growth in our detailed radiation-hydrodynamical models gives information about dust particle radii in every layer at every instant of time. These grain radii are used for computing opacities and determining the radiative acceleration of the dust-gas mixture. It is shown that in the critical cases the effect of the generalized description of dust opacities can be significant, resulting in more intense mass loss and higher wind velocities compared to models using SPL opacities. For well-developed winds, however, grain size effects on mass loss rates and wind velocities are found to be small. Both groups of models tend towards lower degrees of dust condensation compared to corresponding SPL models, due to a self-regulating feedback between grain growth and radiative acceleration. Consequently, the "dust-loss rates" are lower in the models with the generalized treatment of grain opacities. We conclude that our previous results on mass loss rates obtained with SPL opacities are reliable within a wide region of stellar parameter space, except for critical cases close to thresholds of dust-driven outflows where SPL models will tend to underestimate the mass loss rates and wind velocities.

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