Hardy-type operators involving suprema have turned out to be a useful tool in the theory of interpolation, for deriving Sobolev-type inequalities, for estimates of the non-increasing rearrangements of fractional maximal functions or for the description of norms appearing in optimal Sobolev embeddings. This thesis deals with the compactness of these operators on weighted Banach function spaces. We define a category of pairs of weighted Banach function spaces and formulate and prove a criterion for the compactness of a Hardy-type operator involving supremum which acts between a couple of spaces belonging to this category. Further, we show that the category contains specific pairs of weighted Lebesgue spaces determined by a relation between the exponents. Besides, we bring an extension of the criterion to all weighted Lebesgue spaces, in proof of which we use characterization of the compactness of operators having the range in the cone of non-negative non-increasing functions, introduced as a separate result.