It is therefore an object of the embodiments disclosed herein~~invention~~ to provide a process for working up a liquid output from a hydroformylation reaction, in which the decomposition and/or deactivation of the homogeneously dissolved rhodium complex catalyst can be suppressed effectively.

In a first aspect, there is ~~The invention accordingly~~ provide~~d~~ a process for working up a liquid output from a hydroformylation reaction, which output contains aldehyde, high-boiling by-products of the hydroformylation reaction, a homogeneously dissolved rhodium complex catalyst, unreacted olefinically unsaturated compound, synthesis gas and volatile by-products, in which

a) the liquid hydroformylation output is depressurized in a depressurization vessel, resulting in separation into a liquid phase and a gas phase; and
b) the liquid phase obtained in the depressurization vessel is introduced into a separation apparatus in which separation into a liquid phase containing essentially high-boiling by-products of the hydroformylation reaction, the homogeneously dissolved rhodium complex catalyst and small amounts of the aldehyde and a gas phase containing the predominant amount of the aldehyde is carried out; and
c) a liquid, rhodium-containing output is discharged from the separation apparatus,

characterized in that the liquid, rhodium-containing output discharged from the separation apparatus is passed through a filter and solids separated off are removed from the process while the filtrate obtained is recirculated to the hydroformylation reaction.

The process of the ~~invention~~disclosure is suitable for working up a liquid, rhodium-containing output from a hydroformylation reaction carried out in a homogeneous reaction system. For the purposes of the present ~~invention~~disclosure, the term homogeneous reaction system refers to a homogeneous solution composed essentially of solvent, catalyst, olefinically unsaturated compound and reaction product. Rhodium complexes containing organic phosphorus(III) compounds as ligands are used as catalyst. Such complexes and their preparation are known (for example US 3 527 809 A1, US 4 148 830 A1, US 4 247 486 A1, US 4 283 562 A1). They can be used as uniform complex or as a mixture of various complexes. The rhodium concentration in the reaction medium extends over a range from about 1 to about 1000 ppm by weight and is preferably from 10 to 500 ppm by weight. In particular, rhodium is used in concentrations of from 10 to 200 ppm by weight, in each case based on the olefinically unsaturated compound used. The rhodium complex having the stoichiometric composition can be employed as catalyst. However, it has been found to be advantageous to carry out the hydroformylation in the presence of a catalyst system composed of the rhodium complex and free, i.e. excess, phosphorus ligand which no longer forms a complex with rhodium. The free phosphorus ligand can be the same as that in the rhodium complex, but ligands different from this can also be used. The free ligand can be a uniform compound or consist of a mixture of various organophosphorus compounds. Examples of rhodium complexes which are employed as catalysts are described in US 3 527 809 A1. Preferred ligands in the rhodium complex catalysts include, for example, triarylphosphines such as triphenylphosphine, trialkylphosphines such as tri(n-octyl)phosphine, tri(cyclohexyl)phosphine, alkylphenylphosphines, cycloalkylphenylphosphines and organic phosphites, for example tris(2,4-di-t-butylphenyl) phosphite or the bisphosphites known from WO 96/34687 A1. Owing to its ready availability,